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DISCOVERY OF COPPER AND OTHER INDIAN RELICS, NEAR BROCKVILLE.

BY THOMAS REYNOLDS, M. D.

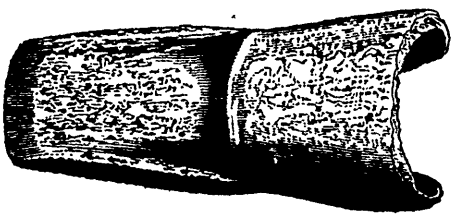
Read before the Canadian Institute, February 16*th*, 1856.

Attention having been recently called to the discovery of ancient copper relics, and other traces of primitive aboriginal arts, on the shores of Lake Superior,* it may not be uninteresting to compare with such remains, others of the same class discovered far to the eastward of the regions which supply the metal from which such weapons and implements appear to have been fabricated.

In excavating the St. Lawrence Canal, at Les Galops Rapids, in the year 1847, a curious collection of Indian relics was brought to light, at one of the beautifully picturesque points on the River St. Lawrence, at the head of the first rapid, or cascade, met with in descending that river. Thus situated at a point where the free navigation of the upper part of the river is first interrupted, this place is likely to have been frequently visited in former times, as a spot where both Indians and voyageurs would be tempted to rest, or camp for the night, before venturing their canoes upon the rapids; and this may perhaps have had to do with the deposition of the relics, discovered in the process of excavating the Canal destined to overcome the impediments which nature had there opposed to the free navigation of the noble river.

* Ante, p. 225.

The following description of such of the relics as have come into my possession, will serve, with the aid of the accompanying illustrations, to convey some idea of their various forms and special characteristics. The most massive of the copper implements, figured here, is an instrument in which will be observed a hollow or socket for a handle: the back, which is here represented, being convex, corresponding to the opposite concavity. The chisel-shaped termination is now blunt, but it retains sufficient indications of its having originally had a sharp edge. This instrument might perhaps answer the purpose of a chisel or gouge for hollowing out wood; but I was struck at first sight of it, with the resemblance it bears to the coulter, or point, of the old Jewish plough. The precise use for which it was designed can now only be surmised; and this might be an interesting matter for further inquiry, as one means calculated to throw light on questions in connexion with the origin of the native American tribes. The subject has been reverted to in relation to another discovery of copper relics found about the same time as those now described, at Penetanguishene, and the speculations thus originated, even if they lead to no very definite or practical results, are at least curious, and suggestive of interesting reflections.

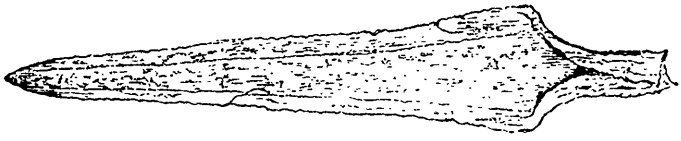


The dimensions of this ancient implement are six inches in length, fully two inches in breadth at the edge, and two and four-fifths at the broadest part of the socket. A second object may be described as a copper knife, of full size, with the edge still tolerably sharp, and bearing marks of considerable use. The point was broken off when it was first discovered; and the handle, which must have been of wood or some other material less durable than the metal blade, had yielded to the ravages of time. In its present mutilated state this instrument measures five inches and three quarters long, and when the blade was perfect was probably not less than eight inches in length.

A third implement, figured here, may be described as a knife, or small dagger, nearly five inches long, and with a hooked extremity, as represented in the annexed wood-cut, de-

signed to serve some unknown purpose of Indian domestic economy, or convenience in war or the chase. This, it may be assumed, was used without any handle attached to it, whatever may have been the purpose to which it was applied.

The fourth copper instrument is a knife or dagger upwards of seven inches in length, including the narrow end for insertion in the haft; and the fifth, which is here figured, is a spear head, rudely



hammered out of the native copper, and presenting unmistakeable evidence of its having been brought to its present shape by the hammer, and entirely without the agency of fire. After being wrought, by means of the hammer, into the rude form of a spear-head, the broad end has been overlapped as shewn in the wood-cut, and roughly hammered to the desired shape, so as to provide it with a short narrow prolongation intended to fit into a handle, or to be secured to it by means of a cord or ligature, though it must have very imperfectly answered the purpose. This spear-head is of considerable thickness, and not much corroded. It is still pointed, and tolerable sharp on both edges; and, imperfect as it seems, was probably a weapon of no slight importance and value among the braves in olden times.

In addition to these weapons and implements of copper, I have in my possession a small pipe mouth-piece, found along with them, measuring an inch and a quarter in length, made of the celebrated Indian red pipe-stone; and also a miniature clay mask, figured here, (though with less minute accuracy, than would have been desirable,) about one half the diameter of the original. It is in some respects a tolerably fair representation of the Indian skull, from which one might fancy it to have been copied. In its shape it struck me as resembling the appearance presented by the skulls found in the same place; and the hollow sockets of the eyes, though doubtless designed only to imitate the Indian masks, were assumed, on its being first found, to prove that it was meant as a representation of the bony structure of the head, and not the fleshy or living subject. This

relic I presume is the head of an Indian idol or household god, modeled by the warrior-artist as a charm or protection in battle, or in the other trials and dangers to which he might be exposed. It is imperfect, having been broken off, some additional piece of workmanship, to which it was attached by the piece partially shown in the wood-cut, projecting behind; but it has no perforation or other indication such as would have shewn its use had it originally formed part of a pipe, which the Indians frequently shaped into a human or animal's head.

Shortly after the discovery of these specimens of ancient Indian art, I had an opportunity of showing them to Mr. T. S. Hunt, during a visit paid by him to Brockville in 1847, and this afterwards led to a correspondence with Mr. E. G. Squier, the well known American Archæologist. In his first letter he remarks: "Through my friend Mr. T. S. Hunt, I learn that you have in your possession some copper implements obtained near the banks of the St. Lawrence. I have in my possession a number of such, corresponding, so far as I can judge from the description, with yours, and which were obtained from the Southern Mounds. I am very anxious to institute comparisons between these relics, and shall be glad to obtain sketches of those in your hands." In consequence of this application I sent drawings to Mr. Squier, which were engraved, and my letter accompanying them published, by the Smithsonian Institute, in their Transactions, vol. 1, p. 201. Since then some cool Yankee has published an account of Indian Remains *found in the State of New York*, copying my drawings, and as much of my letter as suited his purpose. Such being the case: and this discovery of Ancient Copper implements, being, as I believe, one of the most remarkable disclosures of the kind yet noticed in Canada; and, also, possessing some peculiar claims to the attention of those interested in the past history of this continent, owing to their being found so far to the eastward of the copper regions; a detailed notice of the objects in question may not be undeserving of the attention of the Canadian Institute.

All these relics were found at a depth of about fourteen or fifteen feet below the surface, in a soil composed of clay and sand. The shore at the point of land, which is considerably washed by the action of the rapid stream, presents a face of large granite boulders with quartz conglomerate—a fitting resting place for the stalwart forms of a score of skeletons, which were found inhumed in a circular space with their feet towards the centre. Some of the skeletons were of gigantic proportions. The lower jaw of one is in my possession, and is sufficiently large to surround the corresponding bone of an adult of

our present generation. The condition of the bones furnished indisputable proof of their great antiquity. The skulls were so completely reduced to their earthy constituents that they were exceedingly brittle and fell in pieces when removed and exposed to the atmosphere. The metallic remains however, of more enduring material, as also, several stone chisels, gouges made of the same durable material, and probably designed for tapping the sugar maple, and some flint arrow heads, all remain in their original condition, and furnish evidence of the same rude arts which we know to be still practiced by the aborigines of the far west. A few yards distant from this spot, and at about the same depth from the surface, another circular place of sepulture was exposed to view; but here the organic remains had been subjected to the action of fire, and the charred and partly consumed bones, with the charcoal ashes, bore testimony to the fact that the decomposition which time and the action of their mother earth would have produced, had been anticipated by the hand of man and his use of the fiery element. With reference to the question whether these copper remains are of European or native origin, I have only further to remark, that their structure is very rude; that they appear to have been wrought solely by means of the hammer, without the melting pot or the aid of fire; that while they were accompanied by stone and flint tools and weapons, no implements were found made of iron, which would have been the metal chosen by the European artizan; and finally that the copper appears to correspond in quality with the specimens of the native metal now found in such large quantities on the shores of Lake Superior. There is also a curious fact, which these relics appear to confirm, that the Indians possessed the art of hardening and tempering copper, so as to give it as good an edge as iron or steel. This ancient Indian art is now entirely lost.

For these reasons, as well as from the nature of the soil, which is one likely to preserve organic remains for a very long period of time, and the greatly decomposed state in which the bones were found, I should not hesitate to pronounce these instruments, tools and weapons of much older construction than the discovery of Canada by Europeans. In this part of the continent one might expect to find something bearing the stamp of Gallic manufacture as the French were the first to ascend the St Lawrence and remained for some time masters of its shores. Whereas in none of the relics which I have seen is there any thing which one could for a moment suppose to be of French workmanship.

The spot, it may be further added, where these relics were found, was not the usual place of sepulture of the Indians; for I have observed that their burying places were generally at some distance from the river. In this particular vicinity their cemetery is in a fine sandy ridge, some two or three miles inland, where remains are now found of very ancient deposit. From the interest which this discovery excited, I have frequently thought over the matter, and it has occurred to me as not improbable that at this point of the St. Lawrence a battle has been fought, and it requires no great stretch of imagination to fancy at this particular spot a party of Indians descending the river after spending the summer in the great copper country about the higher lakes, bringing with them the rudely formed instruments of the upper country—encamping for the night preparatory to their descent of this the first of the St. Lawrence rapids, attacked by the tribe of Indians whose hunting or fishing grounds were here situated, and after a fatal encounter, the burial of the friends of the victors with their trophies of war; while a few yards distant the bodies of the vanquished were destroyed by fire.

Independent of all theorising, however, the discovery of a collection of copper relics, so far to the eastward of the great copper regions of the upper lakes, is a fact of sufficient interest and importance to be deserving of record.

REPORT ON COPPER IMPLEMENTS FOUND NEAR BROCKVILLE.

BY HENRY CROFT, D. C. L.,

PROFESSOR OF CHEMISTRY, UNIVERSITY COLLEGE, TORONTO.

Read before the Canadian Institute, March 1st, 1856.

A collection of ancient copper implements, dug up on the banks of the River St. Lawrence, in the vicinity of Brockville, having been transmitted, by Dr. Thomas Reynolds, for exhibition before the Canadian Institute, along with various other relics of native art found at the same time; that gentleman accompanied them with a communication, containing remarks on the peculiar condition of the copper, as indicative of a supposed art of hardening and tempering the metal, which is assumed to have been in use by its ancient native workers, but to be now lost. From the allusions made to this same

lost art of native metallurgy in a previous communication,* the subject was remitted to me to report upon, with special reference to the Brockville relics, which were put into my hands for the purpose of experiment and analysis.

The object of the following experiments, accordingly, was to ascertain whether the metal of which these implements are made is identical with the native copper of the Lake Superior Mines, or whether it had been subjected to some manufacturing process, or mixed with any other substance, by which its hardness might have been increased. A careful examination establishes the conclusions here stated:

1stly. No perceptible difference could be observed in the hardness of the implements, and of metallic copper from Lake Superior.

2ndly. The knife or small dagger, with a hook at the end, was cleansed as far as possible from its green coating;

It weighed	32.440	grammes.
It lost in water.....	3.741	"
Hence its specific gravity is.	8.66	

A small fragment, broken off the end of the broad, flat implement, described as a "copper knife of full size," having been freed from its coating, was found to have a specific gravity of 8.58.

During the cleaning of this fragment, a few brilliant white specks became visible on its surface; they appeared to be silver, from their colour and lustre. The structure of the metal was also highly laminated, as if the instrument had been brought to its present shape by hammering out a solid mass of copper, which had either split up or had been originally formed of several pieces. These laminæ, of course, contained air, and the metal was covered with rust, which could not be removed,—hence the specific gravity would naturally be less than if the metal had been dense.

It is probable that the structure of the dagger previously referred to, is the same; but as the coating of oxide, which could not be removed, would have more effect on the small fragment, which weighed only about three grammes, than on the larger dagger blade, the specific gravity of the latter was found to be rather higher.

A portion of very solid copper, from Lake Superior, of about the same weight as the fragment, was weighed in water, and its gravity found to be 8.92; in this piece there were no cavities perceptible.

The specific gravity of absolutely pure copper, varies from 8.78 to 8.96, according to the greater or less degree of aggregation it has received during its manufacture;

* The Ancient Miners of Lake Superior; ante, pp. 236, 237.

Hooked dagger	8.66	
Fragment	8.58	
Native copper	8.92	
Pure copper	8.78	8.96

The small differences between these numbers would lead to the conclusion that the implements were made of pure copper.

The fragment was completely dissolved by nitric acid; and the solution, on being tested for silver by hydrochloric acid, gave a scarcely perceptible opacity, indicating the presence of an exceedingly minute trace of silver. The copper having been separated by hydro-sulphuric acid, the residual liquid was tested for other metals. A very minute trace of iron was detected.

The native copper from Lake Superior was tested in the same manner, and was found to contain no trace of silver, but a minute trace of iron, the quantity being apparently about the same as in the fragment.

From this, it appears that the implements are composed of copper almost pure, differing in no material respect from the native copper of Lake Superior, and not of an alloy of that metal, with any other substance.

It is not by any means probable, from the conclusions resulting from the experiments detailed above, that these implements could have been hardened by any mechanical means; and no process is known at present by which copper can be rendered harder, although its density may of course be increased to a small extent by pressure and hammering.

ECONOMY OF FUEL FOR STEAM MACHINERY.

BY ALFRED BRUNEL, C. E.

Read before the Canadian Institute, March 29th, 1856.

Few questions attract so much attention among practical men at the present moment as that of economising fuel in Steam Machinery especially as relates to the motive power of Railways,—it is indeed a question of vital importance to many of the older Roads in the United States, and though wood for fuel can at present be obtained on the Canadian Railways at rates which do not render it an item of the first importance in the working expenses, yet it is one of sufficient

magnitude to demand attention, and the time is not far distant when it will materially affect the tariff rates at which the traffic can be worked, as is already found to be the case in the New England States.

Any contrivance in discovery, therefore, which tends to reduce the consumption of Fuel in the creation of motive power, is of peculiar importance to the public as well as to Railway proprietors.

The following Table shewing the cost of Fuel in relation to the working expenses and earnings of twelve Roads in the United States and of two in Canada for the year 1855, has been calculated with a view to exhibiting the importance of fuel in Railway Economy.

NAME OF ROAD.	TRAIN MILEAGE IN 1855.	GROSS EARNINGS PER TRAIN MILE IN $.	COST OF WORKING PER CENT OF GROSS EARNINGS.	COST OF FUEL PER CENT OF GROSS EARNINGS.	COST OF FUEL PER CENT OF WORKING EXPENSES.
Boston and Lowell	295,517	$ 1·660	64	15·8	24·7
Boston and Maine.....	583,016	1·650	49	12·0	24·5
Boston and Providence	316,238	1·766	62	19·0	32·0
Boston and Worcester	541,528	1·861	54	15·0	27·4
Boston and Fitchburh.....	451,944	1·572	59	11·7	20·0
Old Colony and Fall River....	408,107	1·601	53	14·0	26·3
Providence and Worcester....	106,183	1·588	53	15·3	25·3
Western	1,021,163	1·830	60	13·0	21·4
Hudson River	929,748	2·011	60	12·6	20·8
New York Central.....	3,554,574	·782	49	9·0	18·8
New York and Erie.....	3,181,878	3	45	8·0	17·5
Northern (Ogdensburgh).....	320,316	1·625	67	4·2	6·2
Ontario, Simcoe and Huron ...	251,417	1·358	67	0·1	13·0
Great Western*	503,781	1·962	51	8·0	13·8

* This is only for the first six months of the year, the last return not being published.

These roads embrace a length of 2,180 miles, and the train mileage for the period covered by the returns amounts to 12,750,000 miles,

the cost of fuel being about $2,675,000. These figures, representing as they do about one-twelfth of the Railways of America, will give a faint indication of the interest involved.

In the above table we have abundant evidence of the effect which the Fuel account has on the profits of Railways, as well as a clear indication of the rate at which that account is increased as the forests disappear in the vicinity of the lines. There is no question but the consumption of wood in our Railways has been increased in their earlier stages by an insufficient estimate of the consequences, and it is doubtless true that less attention has been given to matters affecting it than to any other particular branch of Railway Economy. In England it has been more strictly attended to, but a wide difference between Coke and Cordwood has in a great measure negatived the value of the experience had in that country—the management of the one being quite unsuitable to the other. The time is arrived however, when the subject must receive greater attention, and some recent articles in American periodicals devoted to Railroads evince a desire on the part of our neighbours to enter upon a careful investigation of the question.

It is a received opinion among Mechanical Engineers, that only a portion of the heat generated in the furnace is imparted to the water in the boiler, and experiments have shown that this is owing to the want of a sufficient admixture of oxygen to produce the perfect combustion of the gases evolved from the burning fuel—hence the attempt to introduce a great supply of air at different parts of the furnace.

It was and is still with many a popular belief that the elongation of the flues of a boiler would produce a corresponding economy in the fuel—the flame escaping from the funnels of steamboats, and supposed to be continuous from the furnace, being pointed to as evidence of the escape of a large amount of unappropriated heat—it is now known that this flame is produced by the ignition of the gases on the coming in contact with the fresh air, and a careful set of experiments made by Mr. Stephenson and later by Mr. Armstrong gave conclusive evidence that no corresponding advantages are obtained from lengthened flues.

A recent writer in the American *Railway Times* says:

"There are two causes why all the heat which fuel may furnish is not obtained. First, that the inflammable gases, evolved by the heat, are not all consumed from a want of sufficient supply of oxygen, the air drawn through the fire being only sufficient to decompose more fuel than when decomposed it could burn, or supply with oxygen. The thick smoke, that escapes from a chimney, when fresh fuel is

thrown in, is unconsumed gas, decomposed from the fuel without enough oxygen to burn, although there may have been a sufficient supply of heat."

* * * * * * *

"A second cause why the whole value of the produced heat is not obtained, is that so much is abstracted from the gases in passing through long tubes, that there is not enough left to continue the combustion, although the inflammable gas is still there. That a tube or any substance in the way of the gas does absorb heat enough to prevent the burning of the gases, is proved by the action of Davy's safety lamp. This is a common light, surrounded by a wire gauze, which so absorbs the heat from the flame, as to extinguish the latter at the gauze, by applying fire above the gauze the gas is again kindled, showing plainly that want of heat above had extinguished the flames."

To remedy the waste of heat resulting from these causes Mr. McConnell of the London and North Western Railway (England) introduced in some of his Locomotives what he termed a "*Combustion Chamber*," dividing his flues into two lengths—into this chamber a sufficient quantity of fresh air was introduced to produce the combustion of the gases; escaping unburned from the first length of tubes—in fact producing precisely the same phenomena in the combustion chamber as we frequently notice at the top of steamboat funnels. The arrangement is said to have produced the most satisfactory results as regards economy, though the practical difficulties in carrying it out, have prevented its introduction to general use; enough was done, however, to demonstrate the correctness of the theory, and there is no doubt but a duly regulated supply of oxygen in the tubes at that point in the length where the heat of the escaped gases would be just sufficient to ignite the mass, would be productive of a more complete absorption of the heat generated, than is affected in flues of the ordinary construction.

A most important influence is exercised on the consumption of fuel by the form and position of the heating surfaces through which the heat is transmitted to the water. Mr. Armstrong found that "a cubical metallic box submerged in water, and heated from within, generated steam from its upper surface more than twice as fast as from the sides when vertical, and the bottom yielded none at all. By slightly inclining the box, the elevated side much more easily parted with the steam, and the rate of evaporation was increased, while in the depressed side the steam hung so sluggishly, as to cause overheating of the metal."* Hence the advantages resulting from inclining the fire box

* Tredgold on the Steam Engine, vol. 1, 1850.

sides so as to allow the free escape of steam, and hence the truth of the observation that "the object of the fire box is more to generate heat than to absorb it, and the absorption takes place chiefly in the tubes."

In relation to the tubes Mr. D. K. Clarke says: "There is reason to believe that in the upper semi-circle part of such tube, the efficiency chiefly resides. The winding progressive motion, observable in tubes of considerable diameter, confirms the conclusion, as it is with much probability due to the cooling of the upper portions of the gases of combustion which, as they cool, also become heavier, and descend laterally to make room for the hotter smoke next the bottom of the flue, the general result of which is the spiral motion of the current in its progress forwards."*

The writer in the *Railway Times* has introduced most of the above quotations in his article, apparently for the purpose of paving the way for proposing a new plan of constructing Locomotive Boilers. If Mr. Clarke reasons correctly, however—and his argument appears to have been well considered and based on actual experiment—it is difficult to understand what advantages are likely to arise from the introduction of Montgomery's principle into the construction of the Locomotive Boiler, as proposed by the writer above alluded to, for though there is no doubt but an advantage in point of area would be obtained by applying the heat to the outer instead of the inner surface of the tubes, proportionate to the increased diameter, we are still unable to reconcile the following with Messrs. Armstrong and Clarke's experiments and deductions in relation to vertical free surfaces:

"If the ideas of Clarke and of Overman are correct, the value of vertical flues with the water inside, as compared with the horizontal flues with water outside, will be as follows: neglecting the physical advantage of applying heat to the convex surface so highly estimated by Overman.

One half of the surface of the horizontal tube (the upper half) is available, but this half generates steam twice as fast as the vertical sides of the upright tubes. Thus the amount of evaporation will be the same in either position for the same absolute tube surface, not considering the increase obtained by applying the heat to the increased surface of the outside over the inside."

Now it appears to us that Mr. Armstrong has shown that vertical surfaces are only one half as efficient as horizontal ones

* Railway Machinery, folio 126.

placed over the heat, and Mr. Clarke clearly says that the principal efficiency of tubes is in the upper semi-circle, from which it evidently results that the vertical tube would not be any more efficient, if so much so, as the horizontal one, unless the advantage resulted for the application of the heat to its exterior surface.

There are some good suggestions, however, in the following remarks, and especially in reference to contracting the ends of the tubes by the insertion of ferrules, which we have ever viewed as a serious, though unavoidable evil:

"We now submit the following application of Montgomery's boiler to the locomotive engine for increasing the efficiency of the steam-generating parts. Retaining the common firebox shell, produce it forwards, so that it shall just clear the driving axle, then let the sides drop to within two feet of the rail, and close up the bottom. Next, inside of this, place a rectangular box, which shall be a continuation of the inner fire-box, the top being about 9 inches above the diametric chord of the barrel, leaving a water space of 4 to 5 inches between the sides and bottom of the boxes. Fill the inner box with vertical tubes, the top and bottom being flue plates. The tubes being screwed in at one end, and fitted with a screw thimble at the other, may be removed for cleaning at any time, and will effectually stay the inner box against the immense pressure to which it is subjected. The pressure, being inside of the tubes, will tend to keep the end joints tight, where in the common boiler the reverse is the case.

"That the gases may retain sufficient heat to burn until they are discharged, there should be less tube surface to absorb the heat at the back, than at the front end; a requirement which is easily satisfied by decreasing the number and increasing the size from the front to the back end. *In the common boiler the ferrule area being less than the flue area, a stronger blast is required than is economical, because by drawing hard enough to get the gases through the ferrules, we draw too hard to carry them through the flues at a rate slow enough to admit of a complete extraction of their heat.* By means of the vertical flues we may arrange the gas area in any way we please, making it larger at the fire end, if necessary.

"Again, any amount of oxygen may be applied to the gases at any point of their passage from the furnace to the smoke box, by the admission of fresh air to any part of the barrel; thus the advantage of a combustion chamber (if there is any) is obtained without the sacrifice of a single inch of tube surface, as we are required only to admit the air between the tubes, and not inside of them. This may be done

either by hollow stay bolts, or by larger openings, which may be opened or shut at pleasure.

"If the gases in passing through the boiler are left to themselves, we get without an effort the effect produced by Montgomery's third claim, viz., the application of the heat to the upper half of the tubes, by which circulation is established. And, however we wish to apply the passing heat to the flues, complete control over the motion of the gases may be had by a Venetian blind draught regulator at the smoke-box end of the flues, made in two parts, the upper and lower parts moving independently. Of course, by opening the lower and closing the upper damper, we draw the gases downwards, and *vice versa*.

"It might be objected that so much flat boiler surface would make a form more liable to explosion, than the circular barrel. Experiments lately made by Wm. Fairbairn of England, induced by the bursting of a locomotive fire-box at the flat sides, prove that the flat surfaces are the strongest part of the boiler, or, to use his own words, 'are conclusive as to the superior strength of flat surfaces, as compared with the top, or even the cylindrical part of the boiler.' His experiments show that two plates, 1-4 and 3-8 in., connected by screw stay bolts at a distance of 4 inches from centre to centre, will resist over 1000 lbs., square inch, and where 5 inches from centre to centre over 500 lbs."

By such a plan of engine we may always have any amount of heating surface with a moderate sized boiler and a low centre of gravity.

Of course such a boiler would be impossible with inside connections, but apart from the difficulty of keeping the flues tight and preventing an accumulation of ashes and dirt on the lower flue sheet, there does not appear to be any great practical difficulty in the way of construction —though, with the insertion of ferrules in the upper end of the tubes a serious obstacle would be offered to the disengagement of the steam which might result in overheating the metal, and even to explosions.

It has been surmised that the latent heat in water under pressure could be more freely disengaged by the agency of electric currents, and that in this way a great saving of fuel would be effected. We have not until recently seen any definite proposal as to the mode of applying this agency. A Mr. Harshman of Dayton, Ohio, however, professes to have made some important discovery in this direction, but the details of his experiments are given in such a manner as not to inspire much confidence in their value. Had the duration of the experiments—the time required to raise the steam to the pressure indicated—the temperature of the water at the commencement—the

quantity of fuel used, and the quantity of water, been carefully noted, the experiment would have possessed much greater value; as it is however, it is sufficient to excite enquiry. It is not improbable that electricity may exercise an influence in converting water into steam, which has never been assigned to it, and we may yet live to see the combined action of electricity with heat and water produce as great an extension of the application of steam power as was effected by the improvements of James Watt.

Mr. Harshman's theory is: that water contains a large amount of latent heat, which, under some circumstances is capable of being rapidly and dangerously developed, and under others, of being gradually freed without danger, and that to accomplish this it is necessary to establish an electric or galvanic equilibrium in the boiler. That an iron boiler, covered in all but its fire surface and flues, with a copper coating, generates steam very rapidly, saving half the fuel, and cannot be exploded. It may rupture by over-pressure and relieve itself by allowing an escape of steam, but it cannot explode. The correctness of this theory Mr. Harshman says he has illustrated by repeated experiments, in every one of which the result has been uniformly satisfactory. Having satisfied himself on this point, he is now taking measures to bring his discovery and invention to the attention of the public, very justly believing that it will be properly appreciated so soon as sufficient evidence is furnished of its efficacy to prevent the recurrence of a species of calamity highly destructive to life and property.

The following details of the experiments carried on by him are from the *Railroad Record* of the *Railway Times*.

"The experimental boiler employed was a small cylinder without flues, twelve inches long and eight inches in diameter. The cylinder was made of iron 29 inches thick, and the ends somewhat thicker. The seams were riveted and soldered, and the safety valve fastened to the boiler by solder. The furnace was of common construction, without return flue. The boiler was placed in a strong frame of iron, the ends being confined, one by a bar extending across the end, and the other by a square piece of iron in the centre. One half the surface of the cylinder was exposed to the action of the fire, the other half was covered with copper. The ends were also covered with copper. The safety valve was confined by a long wire attached to a spring balance. The fuel employed was hickory wood well dried. The boiler being placed in such a position that its explosion could do no damage, the fire was lighted, and the observers withdrew to a distance to ob-

serve the pressure at the balance, and watch the operation of the experiment. In a few moments, steam had risen to a hundred, a hundred and fifty, and two hundred pounds, and in less than half an hour the balance indicated a pressure of two hundred and sixty pounds. At this point, steam was observed to issue from underneath the copper sheeting. The safety valve was drawn tighter, and the fire continued for ten minutes, steam continuing to issue. The safety valve was then loosed and steam blown off, and the fire put out. On first examination, the boiler seemed only to have opened at the seam around the front head, and at the point where the safety valve was fastened; but subsequent careful inspection shewed that the iron had opened in little fissures in several places which were perfectly tight under any ordinary pressure, but gave vent at the high pressure to which this experiment was carried. The ends of the boiler had bulged out to some extent, and the impression of the square nut at one end was left very distinctly crushed into the copper jacket. The day was clear and cold, with the wind blowing from the West. This experiment was repeated on Saturday with the same result. Now, according to all ordinary experience, the boiler should have burst with great force. Yet we are witness to the fact that it only ruptured and gave vent to the steam as easily as a safety valve usually relieves an ordinary boiler."

Such an experiment, if conducted on a larger scale with similar results, and with all particulars noted as mentioned above, would justify us in attaching great importance to Mr. Harshman's theory. Such experiments cannot be instituted in a satisfactory manner without the expenditure of more money than can generally be spared by private individuals, and it will require the favourable opinion of those whose knowledge of electricity fits them to pronounce on the probability of such results being secured ere the requisite outlay would be made.

THE SOUTHERN SHORES OF LAKE SUPERIOR.

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The vast inland fresh-water sea which constitutes the head reservoir of the great chain of lakes that sweep over the Falls of Niagara, and find their way to the ocean by the River St. Lawrence, has been as yet so slightly encroached upon by the pioneers of modern civiliz-

ation, that the glimpses which even a very partial examination of its shores affords of some of the phenomena peculiar to them, may not be unacceptable to the members of the Institute. With its wide extent of waters, covering an area of thirty-two thousand square miles, a lengthened period of sojourn in the regions with which it is surrounded, and many facilities for their exploration, would be required, in order to satisfy the curiosity of scientific enquirers in relation to their varied attractions. But even a brief visit discloses much that is highly interesting, and that serves at once to illustrate, and to contrast with what comes under the observer's notice elsewhere. Having employed both pen and pencil in noting several of the most striking features which catch the eye from their novelty, a description of some of them may not be unacceptable in the absence of more valuable contributions, even though trenching on the legitimate grounds of the geologist, with the mere notes of an amateur observer.

The settlers on the shores of the great fresh-water lakes of this continent are cognizant of various remarkable formations, differing from the phenomena with which the dwellers on the sea-coast are familiar. Of one class of such, the peninsula, or "Island" of Toronto Bay, is a striking, though by no means singular example. Similar natural barriers—hooks or spits, as they are termed, according to the curved or straight outline of their extremities—are still in course of formation on Lake Erie, as well as at other points on the shores of Ontario, by the waves and currents, under the action of the winds in certain prevailing directions, wasting away salient points of the coast, and depositing the detached debris on a less exposed bottom. Peninsular barriers of this class are to be met with also on the higher lakes, and constitute indeed a striking feature among the littoral features of Lake Superior. Certain peculiarities, however, distinguish the formations of this class in Lake Superior, from those belonging to the lower lakes; and it would seem as if a special character were traceable in such on each of the lakes. Owing to its uniform shallowness, the waters of Lake Erie appear to differ to a certain degree from those of Lake Ontario—which otherwise it most nearly resembles,—in their mode of action and the consequent results; while both present a striking contrast in these respects to Lakes Huron and Michigan, with their main coast lines running nearly due north and south, and thereby subjected to very varied actions from the same winds and currents. This diversity of aspect becomes still more apparent, when the same forces are found in operation, but the materials opposed to this united action are no longer the loose drift

formations of the lower lakes, but the rock-bound coasts of Georgian Bay and Lake Superior.

Availing myself of the partial opportunities afforded by a brief sojourn on some parts of the shores of Lake Superior during last summer (1855) I was much interested in observing some of the singular conformations produced along its varied coast lines by the action of the waves or currents of that magnificent inland sea. Of these, no features are so remarkable as those presented by a portion of the extensive range of sand-stone cliffs which rear their massive fronts, and project their jagged and picturesque cliffs from the southern shore, soon after passing the Grand Sable: the first feature of commanding interest which meets the explorer after leaving the Rapids of Sault Ste. Marie. Here the rounded and slightly undulating shores, with their coast line of sand and loose shingle, is suddenly changed for a long reach of coast, still rounded in its forms, but rising abruptly from the shore in dune-like masses, to a height of upwards of three hundred and fifty feet. At their base the edges of the sand-stone strata are occasionally exposed by the action of the waves, but the greater portion of their surface is formed by sand and debris; and the same materials loosely accumulated on their tops, afford only at rare intervals sufficient soil for the trees, which elsewhere line the whole southern shore of Lake Superior with that unvarying monotony so familiar to the eye of the American traveller. Beyond the Grand Sable, the coast trends rapidly to the southward until it reaches the most southerly point of the lake, in the beautiful and sheltered harbour behind Grand Island: which in some respects reminded me of the magnificent natural harbour in the Clyde, formed by the sheltering barrier of Holy Island, and the bold coast of the Isle of Arran; though in the solitude of its embayed waters it presents a striking contrast to Lamlash Bay, towards which the merchant fleets of the Clyde, and of the whole Irish Channel, may be seen crowding all canvass to escape the dangers of a westerly gale. In approaching this fine natural harbour from the east, the coast presents for upwards of ten miles, a range of rocky cliffs of varying character and elevation, but rising in some places to a height of fully two hundred feet; and it is on a portion of this range of sand-stone rocks that the French voyageurs, from one of its peculiar features, conferred the name of "Les Portails," while they are more generally known to the American traveller by that of "the Pictured Rocks." To this latter name a fresh interest has been recently given by its introduction into Longfellow's Indian "Song of Hiawatha," where,

in his hunting of the Storm Fool, Pau-Puk-Keewis fleeing from Hiawatha:

Sped away in gust and whirlwind,
On the shores of Gitche Gumee,
Westward by the Big-Sea-Water,
Came unto the rocky headlands,
To the Pictured Rocks of Sandstone
Looking over lake and landscape.
And the Manito of mountains
Opened wide his rocky doorways,
Opened wide his deep abysses,
Giving Pau-Puk-Keewis shelter
In his caverns dark and dreary,
Bidding Pau-Puk-Keewis welcome
To his gloomy lodge of sandstone.

* * * * * * *

Then he raised his hands to heaven,
Called imploring on the tempest,
Called Waywassimo, the lightning,
And the thunder, Annemeekee;
And they came, with night and darkness,
Sweeping down the Big-Sea-Water,
From the distant Thunder Mountains;
And the trembling Pau Puk-Keewis
Heard the footsteps of the thunder,
Saw the red eyes of the lightning.
And Waywassimo, the lightning,
Smote the doorways of the caverns,
With his war-club smote the doorways
Smote the jutting crags of sandstone;
And the thunder, Annemeekee,
Shouted down into the caverns,
Saying, "Where is Pau-Puk-Keewis!"

It is something altogether novel to have the spirit of its own national poetry thus associated with scenes of this new world, and breathing over them a living soul akin to that which haunts with such thrilling memories the cave of Staffa and the rocky shores of Iona. The striking, and in some cases, singularly beautiful forms of the Pictured Rocks, have been hewn out of the sand-stone cliffs along the south-eastern shore of the lake, by the prolonged action of the winds and waves sweeping from "the distant Thunder Mountains" of the far north through unrecorded centuries, and exhibit all the fantastic and picturesque variety which is so characteristic of the wave-wrought sculpturings of Nature's architecture. They have been described with considerable minuteness in Messrs. Foster and

Whitney's "Report on the Geology of Lake Superior," and are there spoken of in general terms as "a series of sand-stone bluffs, extending along the shore of the lake for about five miles, and rising in most places vertically from the water, without any beach at the base, to a height varying from fifty to nearly two hundred feet. Were they simply a line of cliffs, they might not, so far as relates to height or extent, be worthy of a rank among great natural curiosities, although such an assemblage of rocky strata, washed by the waves of the great lake, would not, under any circumstances, be destitute of grandeur. But in the Pictured Rocks there are two features which communicate to the scenery a wonderful and almost unique character. These are, first, the curious manner in which the cliffs have been excavated and worn away by the action of the lake; and second, the equally curious manner in which large portions of the surface have been colored by bands of brilliant hues."*

The rocks thus referred to have been figured by the authors, as well as by Schoolcraft; but they have been greatly less successful with their pencils than their pens. The former state their intention of supplying the want of a full and accurate description of the extraordinary locality, "partly by a series of illustrations, which, however deficient in artistic effect, have the merit of being careful copies from nature." But after having sailed close in shore, along the whole range of these magnificent cliffs, and availed myself of opportunities of sketching some of their most striking features, I must state that while the subjects of these illustrations can, in nearly every case, be recognised, they are altogether deficient in detail, and convey not only a very imperfect, but in many cases an inaccurate idea of the objects represented. It is not improbable that the original drawings may have been more faithful in their representations than the lithographed copies. Certainly, at least, faith in the fidelity of the latter is not strengthened by such supplementary features as a birch-bark canoe rigged with a high square sail, with one of its crew seated on the front cross-spar, as on the seat of an ordinary boat, and an Indian with flowing scalp-lock standing steering in the stern! (Plate IX.) Such artistic incongruities are much more suggestive of the Broadway lithographer's than of the surveyor's pencil.

The Pictured Rocks constitute a succession of bold promontories rearing their lofty and fantastic façades of natural architecture directly from the water's edge. The Indian name of these cliffs, *schkue-archibi-kung*, or "the end of the rocks," implies their being first

* Reports of the Geology of the Lake Superior Land District. Vol. II., p. 125.

visited by the Indians in the passage from the western regions going eastward down the lake towards the Sault Ste. Marie. Tracing their picturesque details in this direction, the voyager on sailing inside Grand Island, towards the shore, gradually approaches a range of stratified sand-stone cliffs, banded in layers of white, yellow, red, and deep-brown strata, and streaked with strongly-marked veins of perpendicular coloring, occasioned apparently by the water oozing through the seams impregnated with metallic oxides, or other coloring matter, and distributing it over the broad bands of white sandstone which constitute the main mass of the rock, and lie between the thin layers of colored rock or shale. In describing one magnificent segmental curve of the cliffs, to which, from its lofty and regular proportions, Messrs. Foster and Whitney have given the name of "The Amphitheatre," they remark: "It is in this portion of the series that the phenomena of colors are most beautifully and conspicuously displayed. These do not by any means cover the whole surface of the cliff, even when they are most conspicuously displayed, but are confined to certain portions of the cliffs in the vicinity of the Amphitheatre; the great mass of the surface presenting the natural, light-yellow, or raw sienna color of the rock. The colors are also limited in their vertical range, rarely extending more than thirty or forty feet above the water, or a quarter, or a third of the vertical height of the cliff. The prevailing tints consist of deep-brown, yellow and grey; burnt sienna and French grey predominating. There are also bright blues and greens, though less frequent. All of the tints are fresh, brilliant and distinct, and harmonize admirably with one another, which, taken in connection with the grandeur of the arched and caverned surfaces on which they are laid, and the deep and pure green of the water which heaves and swells at the base, and the rich foliage which waves above, produce an effect truly wonderful." This aspect accordingly, predominating over the other striking features of these rocks, suggested their English name, while the voyageurs of French descent, conferred on them a designation derived rather from their most characteristic forms. Many portions of the cliffs are indented by wedge-shaped recesses, which leave the intervening rock projecting like the wasted round towers or bastions of an ancient castle, while the loose soil and shale at top, yielding more freely to the action of the atmosphere, and of moisture and frost, have most frequently assumed the form of a conical roofing, greatly adding to the artificial look of the whole. In one group, especially, a little to the west of the magnificent natural arch styled "Le Grand

Portail," the illusion was for the time complete, which suggested to the fancy one of the ancient ruins of Roman masonry still to be seen in the south of England, where the tiers of chalk or stone are banded by occasional layers of the flat-tile Roman brick.

The cliffs are hollowed, arched, and perforated into caverns, evidently by the action of the waters when at a much higher, and varying relative level. Two groups of these, designated respectively the "Chapel" and the "Miner's Castle," have been excavated into aisles, arched recesses and columns, so as to rival the most picturesque ruins of the castled Rhine; while overhead the foliage of the uncleared forest crests their summits, and at one spot near the Chapel Rock, a beautiful cascade dashes in white foam over the cliffs into the Lake:

> "The rolling stream, the precipice's gloom,
> The forest's growth, and G..... walls between,
> The wild rocks shaped as they had turrets been
> In mockery of man's art."*

"Le Grand Portail" is another of the more striking features of this scene. A huge quadrangular mass of rock projects out several hundred feet from the main range of cliffs, terminating, at their eastern end, one long and singularly picturesque group. Looking on this at a little distance, from the northwest, it presents the appearance of a castellated structure flanked on the west by two massive, but time-worn bastions with an irregular curtain wall between; and by a boldly projecting circular tower. A square, but time-worn mass terminates it on the east, while between, an elliptical arch seemingly from certain points nearly symmetrical in structure, appears to have been thrown over the intervening space, forming the Grand Portal, the dimensions of which, as given by the United States geologists, are about one hundred feet in height, and one hundred and sixty-eight feet wide at the water level. This forms the entrance into a vast cavern, or domed hall, hewn by the waves out of the projecting mass of rock, and perforated through another side of the cliff; while smaller arches and caverns correspond to the posterns and sally-ports of the ancient fortress which it so much resembles. Of this magnificent natural formation, the view in "The Geology of the Lake Superior Land District," is so deficient in every characteristic detail, with the single exception of a representation—far from minutely correct,—of the great archway which gives the name to the group of rocks: that in comparing it with the original, I conceived I must be looking on a sketch of some other portion of the Pictured Rocks to

* Childe Harold, can. III., s. lxi.

be afterwards seen. Instead of the square rectangular mass, with perpendicular walls, as there figured, it is worn away around the base, and to a considerable height, leaving the upper portions, especially on the western side, overhanging like the projecting turrets of the mediæval castle to which it has already been compared. The arch, also, is a flat, segmental, rather than a semi-circular arch, and its side-wal' are jagged and under-worn, so as greatly to add to the picturesque outline of the mass, without marring the castellated character which pertains to is as a whole.

But the most wonderful illusion of all the fantastic sports of nature in this singular scene, is what is called the "Sail Rock." Here a quantity of debris has accumulated in a sloping tail at the base of the cliff, and on this a group of huge detached slabs, dislodged from the rock above, have been thrown together so as to represent the hull, jib, and mainsail of a sloop. These large slabs, one of them measuring nearly forty feet in height, rest against the cliff with their faces nearly at right angles to it; and when I saw the group, about midday under a bright summer sun, the whole of the cliff was in shadow, while the sun illuminated these detached blocks, and produced an effect so complete, that had I not examined them closely before seeing them under this aspect, it would have been scarcely possible to doubt that we were looking on a sloop-rigged vessel running in-shore, in full sail, for some inlet or harbor concealed by the rocky coast.

This remarkable range of rocks lies in the centre of the long indentation, which, sweeping from Keweenaw Bay eastward to White Fish Point, forms the bay behind Grand Island, the coast most distant from the northern shores of the Lake. Here they have been exposed through unnumbered ages to the action of the northerly winds, which have materially affected the diverse characters of the northern and southern shores of the Lake, while the process of upheaval, prolonged probably through vast periods of time, has contributed no unimportant share in the operations by which their present forms have been produced.* Lying as they do in the arc of the bay,

* While the elevation of the land, as the chief cause of the more remarkable changes dependent on the relative levels of the Lake and its shores, is proved by very obvious evidences, it is well known that the level of the Great Lakes is not of that unvarying and constant character which pertains to the ocean; and as the special attention of the Institute has been directed to the "rise and fall of the Lakes," the following notice, extracted from the Lake Superior Journal of July 23, 1851, by the U. S. geologists, may be worth repeating here:—"While at Grand Island, a few days since, Mr. Williams gave us an account of a remarkable instance of the sudden rise and fall of water, at that place in 1845. On a certain day, with

and behind Grand Island, they are remote from the regular line of traffic, and unless the voyager on Lake Superior avails himself of a canoe, or joins a pleasure party specially bent on exploring the attractive and picturesque features of the Lake, he may pass over its wide extent of waters, without obtaining more than a remote glimpse of the general aspect of the cliffs which present so many striking features when approached and viewed in detail.

To the westward of Grand Island, the traveller who pursues this voyage up the Lake, comes once more on rocky cliffs in the vicinity of Marquette. On the Marquette Landing,—so named after Father Marquette, the Jesuit missionary, by whom the Mississippi was reached in 1673,—were piled the rich products of the "Jackson Iron Mountain," twelve miles distant; and in the vicinity of the Landing there are groups of abraded and scratched trappean rocks, rounded and worn down, excepting where some of the deeper fissures and hollows lying beyond the reach of the active agent in the polishing of their exposed surfaces, show by the contrast the force of the action that must have been at work to smooth and round them into their present forms. Availing myself of a pocket compass, I noted that the scratches on the abraded surface of the rocks run nearly due N. and S., slightly inclining to N. E. and S. W. Immediately to the north of Marquette, the bold promontory of Presque Isle attracts attention from its rocky coast, presenting in some respects a marked contrast to the Pictured Rocks, though, like them, also indented and hollowed out into picturesque masses, and pierced with wave-worn caverns: the work of a former era, when the relative levels of the Lake and shore greatly differed from their present relations to each other. The rocky coast consists of a water-worn red sandstone (Potsdam?) overlying a dark weathered igneous rock, granite or trap. Of this—with the exception of the Pictured Rocks, the boldest coast of the whole southern Lake shore,—I speak chiefly from observations made while sailing along in close vicinity to the picturesque headlands which here project into the Lake. Parts of the coast which I was able to examine are granite, and a bold rocky island which rises abruptly out of the water, about six miles from the shore, bears the name of Granite Island from its geological formation. But it is just at Presque Isle that the crystal-

out any appearance of wind on the Lake, the water rose and fell several times during the day, from four to five feet above high water mark. The weather was calm before and after the occurrence, and this was the case for a hundred miles, at least to the northwest of the Island, for Captain Smithwick, of the schooner Algonquin, was that day off Copper Harbor, and nearly becalmed."

line schists, with their intermingling masses of trappean and quartz rocks, richly impregnated with the specular and magnetic oxide of iron, pass into the granite and sandstone rocks, which intervene between the ferriferous formations and the copper-bearing traps of Keweenaw Point, and it is of this very locality that the authors of the report on the geology of the district remark: "It would be difficult to select another spot along the whole coast, where the rocks of so many epochs, from the oldest to the most recent, are represented. It contains an epitome of nearly the whole geology of the district."

With the exception of these strikingly marked rocky lines of the coast, the general character of the Southern Shore of Lake Superior is devoid of any very bold features, but consists almost entirely of the same rounded elevations and terraces, with gently sloping shores, or crumbling escarpments of drift, with which we are familiar on the lower lakes; and covered every where with dense forests down to the water's edge. In no place do the surrounding hills, to be seen inland, rise to such an elevation as to present any very striking general feature in the view, although on landing and exploring the scenery lying beyond the coast line, some bold and striking features in the landscape well repay the toil; as in the magnificent cliffs of trappean rocks running in a southwesterly direction from Keweenaw point to the Montreal River, and presenting their perpendicular sides to the south-east.

In reference to this character of the Southern Shore, Mr. J. Elliot Cabot, the author of a narrative of the Tour undertaken under the direction of Professor Agassiz in 1848, remarks* "Lake Superior is to be figured to the mind as a vast basin with a high rocky rim, scooped out of the plateau extending from the Alleghanies to the Mississippi Valley, a little to the south of the height of land. Its dimensions according to Captain Bayfield, are three hundred and sixty miles in length, one hundred and forty in breadth, and fifteen hundred in circumference. The mountainous rim is almost unbroken; its height varies from the average of about three or four hundred feet, to twelve or thirteen hundred; the slopes are gradual towards the north, and abrupt on the opposite side, so that on the north shore the cliffs rise steeply from the water, whilst on the south it is said the ascent is more gentle, the abrupt faces being inland. This difference of formation, joined to the prevalence of northerly winds, has given very different aspects to the two shores; the southern showing broad sand-beaches and remarkable hills of sand, whereas on the north

* "Lake Superior, its Physical Character," &c., p 123.

shore the beaches are of large angular stones, and sand is hardly to be seen except at the mouths of rivers. The rivers of the southern shore are often silted up, and almost invariably, it it said, barred across by sand spits, so that they run sometimes for miles parallel to the lake, and separated from it only by narrow strips of sand projecting from the west." In these remarks it will be seen that the writer speaks only in part from personal observation, though his observations receive confirmation from the detailed survey by Messrs. Foster and Whitney of the chief features of the southern shore.

The alteration in the relative levels of land and water, which is so strikingly recorded on the exposed face of the rocky coast, also finds its record in the less marked features of the river beds; and a discovery of copper relics, already brought under the notice of the Institute,* made during the past year near the mouth of the Carp River, some two miles to the south of Marquette, also disclosed evidence of an ancient river bed, situated about ten feet above the level of its present channel. On this subject Professor Agassiz, after describing the terraces, which form a striking feature of the lake shore, remarks:† "We must consider also, the river terraces which present similar phenomena along their banks all around the lake, with the difference that they slope gradually along the water courses, otherwise resembling in their composition the lake terraces, altogether composed of remodelled glacial drifts, which, from the influence of the water and their having been rolled on the shores, have lost, more or less, their scratches and polished appearance, and have assumed the dead smoothness of water pebbles. Such terraces occur frequently between the islands, or cover low necks connecting promontories with the main land, thus showing on a small scale, how, by the accumulation of loose materials, isolated islands may be combined to form larger ones, and how, in the course of time, by the same process, islands may be connected with the main land.

The lake shores present another series of interesting phenomena, especially near the mouth of larger rivers emptying into the lake over flats, where parallel walls of loose materials, driven by the action of the lake against the mouth of the river, have successively stopped its course and caused it to wind its way between the repeated accumulation of such obstacles. The lower course of the Michipicotin River is for several miles dammed up in that way, by concentric walls across which the river has cut its bed, and, winding between them, has

* Ante, page 235.

† "Lake Superior, its Physical Character," &c., pages 414, and 415.

repeatedly changed its direction, breaking through the successive walls in different places." To these Mr. Foster has given the name of river-belts.

A striking example of this phenomenon attracted my attention from the gigantic scale on which it is exhibited, as well from some features peculiar to the particular case referred to; and a brief reference to it may be the more pardonable, as neither Professor Agassiz nor Messrs. Foster and Whitney appear to have extended their observations so far west as the Fond du Lac, where it occurs. The northern shores of Lake Superior may be roughly described as forming the segment of a circle, which terminates at its western end in the Fond du Lac, a comparatively narrow and deep inlet, or cul de sac, into which the waters of the St. Louis, Nemadji, and Aloues Rivers empty their streams. At this point the lake is exposed to the full force of northern and north-westerly winds, while the magnitude of the St. Louis River opposes to the silting action of the Lake a force well calculated to develope some of the most striking features of the phenomena in question. From either side of the Lake two long and narrow tongues of land project towards each other, leaving between their extreme points only a narrow channel, 2400 feet in width, to admit of entrance into Superior Bay, and to afford an exit for the waters of the rivers which there enter the lake. The northern tongue, which is called Minnesota Point, extends across the bay, between six and seven miles, while its average breadth is only seven hundred feet, and on the extreme point of it a picturesque group of Indian lodges shows that the aborigines have not yet deserted the shores of the great lake. Wisconsin Point, which stretches towards it from the southern shore, measures fully three and a half miles in length; while, within this outer barrier, a second series of walls is constructed independently by each of the rivers; one of these on the western side of the Nemadji forms an irregular and narrow tongue of land, about 4500 feet in length, and, with the broader delta of the same material, on its eastern side, projects the channel of the river far into the Bay of Superior. The inner peninsular formations at the mouth of the St. Louis are on a still larger scale, and run parallel to the Minnesota Point. The northern St. Louis Point stretches towards the southern one, across the bay of St. Louis, at the mouth of the river, fully one and a half mile in length, and smaller formations show the same process going on in the development of inner concentric lines. This remarkable series of spits and river-belts, it will be perceived, is on a scale of magnitude, far surpassing anything else to be

met with along the shores of the great lakes, and is rather to be compared in its largest features, with such oceanic structures as those which the currents of the Atlantic have built up on the New England coast. On the shores of the Bay of Superior at the mouth of the Nemadji River, the site of the future town of Superior has been selected, and already plans are organising for constructing a railroad to the Mississippi, and thus completing by this northern lake-route a line of connexion between the Gulf of Florida and the great northern chain of lakes which find their outlet in the Gulf of the St. Lawrence. To the traveller fresh from the scenes of ancient European civilization, and influenced by the preconceived ideas naturally engendered by the circumstances of countries settled ages ago, and long densely populated, the opening up of a highway through the wilds of these western forests, and the planning and laying out of a city in this remote wilderness, seem chimerical in the extreme. Nevertheless, the proposed railway will only restore, for the new occupants of this continent, the ancient route by which the metallic treasures of these northern wilds were distributed throughout the regions watered by the Mississippi, and the prized sea shells of the Gulf of Florida, with the more substantial products indigenous to southern latitudes, were transferred to the shores of the great northern lakes. It was impossible to avoid feelings of a lively interest in looking on the first clearings, and the commencement of a pier and corduroy road for the city in embryo, destined, it may well be believed, to be the Chicago of Lake Superior, and to rival in magnitude, and in the rapidity of its growth, the most prosperous among the great cities of the new world. Viewed in this light, the remarkable features of Superior Bay and its tributary rivers seemed to possess a peculiar interest, thus seen in their natural state, the gradual formation of ages, and all untouched by the hand of man; presenting in this, as in so many other respects, a striking contrast to the ancient historic rivers of Europe, with their dykes and piers, and breakwaters, the monuments of enterprise and engineering skill, pertaining, like the dykes of the Essex Marshes on old Father Thames, to a date nearly coeval with the Christian era, or reaching backward, like those of the delta of the Nile, to the birth time of history and the infancy of the human race.

A NEW PROOF OF THE PARALLELOGRAM OF FORCES.

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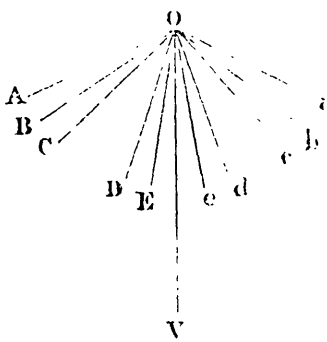


In the following proof it is merely assumed that the direction of the resultant of two equal forces bisects the angle (being less than two right angles) between the directions of the forces.

If $AOa = m\theta$, $BOb = (m-1)\theta$, $COc = (m-2)\theta$..... $DOd = 2\theta$, $EOe = \theta$, θ being a right angle, and m being a whole number; and if OV bisect the several angles AOa, BOb, &c.; the resultant of two forces, each equal to unity, in OA and Oa, lies in the direction OV. Call it R_m; and let R_{m-1}, R_{m-2}, ... R_2, R_1, represent the resultants, likewise in OV, of the same forces, when they act in OB, Ob, in OC, Oc, &c. Then a unit of force in OA, and another in OC, are together equivalent to a single force R_1 in OB. Also a unit of force in Oa, and one in Oc are together equivalent to a single force R_1 in Ob. Therefore a unit of force in each of the lines OA, Oa, OC, Oc, may be replaced by a force R_1 in each of the lines OB, Ob. But the resultant of a unit of force in each of the directions OA and Oa, is R_m, in the line OV; the resultant of a unit of force in each of the directions OC and Oc, is R_{m-2} in OV; and the resultant of a unit in each of the directions OB and Ob is R_1 R_{m-1} in OV. Therefore,

$$\begin{aligned} R_m + R_{m-2} &= R_1\ R_{m-1} \\ R_{m-1} + R_{m-3} &= R_1\ R_{m-2} \\ \vdots \quad\quad \vdots &\quad\quad \vdots \\ R_3 + R_1 &= R_1\ R_2 \\ R_2 + 2 &= R_1^2 \end{aligned}$$

And similarly,

If R_1 may be assumed equal to $2\cos\phi$, the above equations become $R_2 = 2\cos 2\phi$, $R_3 = 2\cos 3\phi$,.....$R_m = 2\cos m\phi$. Now, to shew that the assumption $R_1 = 2\cos\phi$ is legitimate, it might perhaps be enough to observe that the resultant of two forces cannot be > than the sum of the forces, so that R_1 must be intermediate be-

tween zero and 2; and hence its value can always be represented by $2\cos\phi$. But since it is desirable to take as little for granted as possible, I shall demonstrate that R_1 lies between the specified limits, without availing myself of this additional axiom. Should R_1 *not* lie between zero and 2, it may be denoted by $x+x^{-1}$, x being a positive quantity; and then $R_2 = x^2 + x^{-2} \ldots\ldots R_m = x^m + x^{-m}$; where all the quantities, R_2, R_3, R, are positive. But this is impossible: for, $\frac{\theta}{2}$ being $< \frac{\pi}{2}$, it is plain that there is some number m, such that m times $\frac{\theta}{2}$ is intermediate between $\frac{\pi}{2}$ and $\frac{3\pi}{2}$, in which case R_m, the resultant of two equal forces, which act in the directions of the lines containing the angle $m\theta$, is negative. Consequently R_1 never can be > 2; and therefore we can assume

$$\begin{aligned} R_1 &= 2\cos\phi. \text{ Hence also} \\ R_2 &= 2\cos 2\phi \\ &\vdots \qquad\quad \vdots \\ R_n &= 2\cos n\phi. \end{aligned}$$

In proceeding to determine ϕ, we shall inquire after its least positive value, which must be $< \frac{\pi}{2}$. Now I say that the least multiple of $\frac{\theta}{2}$ which exceeds $s\pi + \frac{\pi}{2}$, is the same with the least multiple of ϕ, which exceeds $s\pi + \frac{\pi}{2}$; s being any whole number. For suppose that the law holds as far as $(s-1)\,\pi + \frac{\pi}{2}$. Represent by

$$h\,\frac{\theta}{2},\ (h+1)\,\frac{\theta}{2},\ \ldots\ldots\ (k-1)\,\frac{\theta}{2}$$

the multiples of $\frac{\theta}{2}$ between $(s-1)\,\pi + \frac{\pi}{2}$ and $s\pi + \frac{\pi}{2}$. Then since the quantities R_h, R_{h+1}, $\ldots\ldots$ R_k, have all the same sign, the angles $h\phi$, $(h+1)\,\phi$, $\ldots$ $(k-1)\,\phi$, of which they are the double cosines, must be betwixt $(s'-1)\,\pi + \frac{\pi}{2}$ and $s'\pi + \frac{\pi}{2}$, s' being a whole number. But $h\phi$ lies between $(s-1)\,\pi + \frac{\pi}{2}$ and $s\pi + \frac{\pi}{2}$; therefore, $s' = s$; and $(k-1)\,\phi$ agrees with $(k-1)\,\frac{\theta}{2}$ in being $< s\pi + \frac{\pi}{2}$. But $\frac{k\theta}{2} > s\pi + \frac{\pi}{2}$; and, since $\frac{k\theta}{2}$ gives rise to a resultant of a

different sign from R_{k-1}, $\cos k\phi$ has changed its sign; that is, $k\phi$ is between the new limits, $s\pi + \frac{\pi}{2}$ and $(s+1)\pi + \frac{\pi}{2}$. Thus, the least multiple of $\frac{\theta}{2}$ which exceeds $s\pi + \frac{\pi}{2}$, is the same with the least multiple of ϕ, which exceeds $s\pi + \frac{\pi}{2}$; and the law holds universally, if it can be shewn to hold in one instance. But reasoning exactly similar to that which we have just employed, proves it to hold when $s=0$. Therefore it is universally true. This leads at once to the conclusion that $\phi = \frac{\theta}{2}$. For take

$$k\phi = s\pi + \frac{\pi}{2} + p, \; p \text{ being} < \phi.$$

$$\text{Then } k\frac{\theta}{2} = s\pi + \frac{\pi}{2} + q, \; q \text{ being} < \frac{\theta}{2}.$$

$$\therefore \; k\left(\phi - \frac{\theta}{2}\right) = p - q.$$

But by taking s sufficiently large, k may be made as great as we please, while $p-q$ retains a limited value. Therefore the equation, $k\left(\phi - \frac{\theta}{2}\right) = p - q$, cannot subsist, unless $\phi = \frac{\theta}{2}$. That is to say: the resultant of two forces, each equal to unity, and whose directions make an angle θ less than a right angle, is $2\cos\frac{\theta}{2}$.

The proof of the Parallelogram of Forces, in the most general case, follows from the result now obtained, by a few easy and well known steps, which it is not necessary to state.

REVIEWS.

Notes on Central America; particularly the States of Honduras and San Salvador: their geography, topography, climate, population, resources, productions, etc., etc., and the proposed Honduras Interoceanic Railway; with original maps and illustrations. By E. G. Squier, formerly Chargé d'Affaires of the United States to the Republics of Central America. New York: Harper & Brothers. 1855.

The title page of this volume, of which the above gives only a partial conception, will remind some readers of rarely read dumpy

quartos and elaborate folios of the seventeenth century, in which the author, after having invested whole dungeons of learning in his ample pages, seems resolved to write the work over again on his first leaf. Caxton, and Chepman, and Wynkyn de Worde, got on very well without the modern invention of a title page; and the tendency in our own day is—if not altogether to follow their example in dispensing with it,—at least to make, of such "frontispieces," mere titles, and not indexes, catalogues-raisonnés, and tables of contents. The Author of "Notes on Central America," however, has sundry and diverse purposes in view, which even his ample title only embraces under the comprehensive "etc., etc." He has not only to set Ethnologists and Geographers right in relation to the country and its inhabitants, and to instruct the world at large as to the true line for the inter-oceanic railway or canal which shall wed the Atlantic and Pacific Oceans, but he has to nip in the bud "the pretensions of the British Government," and put both hemispheres for the first time in possession of the true bearings of this mysterious Central American difficulty between England and the States, which—notwithstanding Mr. Squier's goodly octavo, and many subsequent elucidations, official and unofficial—is still a mystery: vague, windy, and full of empty bluster, to not a few. A single extract from what the author styles his geographical introduction, will sufficiently shew his animus in this latter direction. After commenting on the imperfect data and blundering inaccuracies of Map-makers, excusable till recently by the unimportant nature of the country, he adds:

"Now, however, the case is widely different: not only is the value of Central America, in every point of view, beginning to be appreciated, but the enterprise of our people is setting in that direction in a full and increasing current. Apart from these strictly geographical errors, there are others in the various maps of Central America which are without apology and excuse; I mean the servile perpetuation in American maps of the arbitrary political subdivisions of the country, made under English authority, to sustain the pretensions of the British Government. The servility on the part of American map-makers shews how little pains they use to verify the facts which they undertake to present, and how profoundly ignorant they have continued to keep themselves of the issue of the scrutiny to which, in Central America, British pretensions have been subjected. Several maps have been published within a year in the United States which are obnoxious to the severest censure on this score.

"I have selected, as an illustration of the justice of these censures, and as affording an opportunity of correcting several surprising blunders, a sheet map, entitled "JOHNSTON'S ILLUSTRATED AND EMBELLISHED MAP AND CHART OF THE NEW WORLD. *New York*, 1844." And here I may observe that, although this map, so far as Central America is concerned, both geographically and politically, is full of the most egregious errors, yet it is in no degree more open to criticism than nine-tenths

of the maps of equal pretensions which have been published in the United States. I. For the first time in any map, we find Vera Paz laid down as a distinct state. It is now, as it has always been, a department of the province and state of Guatemala. 2. The British establishment of Belize, the boundaries of which are clearly defined by the treaties between England and Spain as extending only from the Rio Jabon to the Rio Hondo, is represented as including more than four times the amount of territory legitimately pertaining to it, and extending from the Rio Hondo down to the Bay of Amatique. No such limits were ever conceded by Spain, nor by the inheritors of her territorial rights in that quarter of the world, nor have they ever been recognised by the United States or any other civilised country. They are impudent pretensions, which map-makers in England, accessory to the schemes of their own government, have adopted without scruple. The representation of the State of Michigan as a part of Canada West could not be more at variance with truth; and the acceptance of such pretensions in respect to Michigan by American map-makers would not be one whit more absurd than this servility to English authorities in the political divisions of Central America. 3. Honduras, which extends from sea to sea, having a frontage of upward of fifty miles on the Pacific (Gulf of Fonseca), is represented in this map as entirely cut off from that ocean by the states of San Salvador and Nicaragua, which are designated as contiguous; whereas, as I have said, they are separated by the territorities of Honduras. 4. Nearly one-third of Central America is assigned to the "Mosquito Shore," which is here represented as a distinct and sovereign state. The term "Mosquito Shore" never had a political sense, but has always been used geograpically to designate a portion of the eastern coast of Central America. The Indians known as "Mosquitos" are only a few thousands of miserable savages, who are strictly confined to the coast, and never had establishments of any kind inland. Essentially fishers, they find a scanty subsistence in the numerous lagoons and creeks near the sea, their only traffic consisting of a few turtle-shells and a little sarsaparilla. Even if these savages were entitled to rank as a nation, they have not, nor could they ever have, the shadow of a pretense of sovereignty over the fractional part of the wide expanse of territory which this map assigns to them. But they have no title of sovereignty over any portion of the country, however small; they do not claim it for themselves; it is only set up on their behalf by Great Britain for sinister purposes, and, so far from being admitted, is positively denied by the United States and every other nation of the globe. The portion of territory assigned by this map to the fictitious Mosquito nationality above the Rio Wanks or Segovia belongs to Honduras; the part below pertains to Nicaragua. 5. The northern boundary of Costa Rica is inaccurate, and not conceded by Nicaragua. But this error may be excused on the ground of conflict of claims between those states. It is, perhaps, not to be expected that a map-maker should have the means of testing the merits of questions of this kind. The true northern boundary line of Costa Rica, as defined in her own Constitution, extends from the lower mouth of the River San Juan to the Rio Salto de Nicoya or Alvarada, falling into the Gulf of Nicoya. Consequently, the territories of Costa Rica do not touch the River San Juan nor Lake Nicaragua, but fall far to the southward of both. The map in question is therefore erroneous in this respect. In short, so far as Central America is concerned, it has no claim to be regarded as an authority. It can serve no purpose except to confuse and mislead.

"It may be claimed that the map here alluded to is general in its character, and

does not pretend to specific accuracy. Such, however, is not the case with a large map recently published in London, which has very generally been accepted as an authority, namely, "MAP OF CENTRAL AMERICA, *including the States of Guatemala, Honduras, San Salvador, Nicaragua, and Costa Rica, etc., etc., by* JOHN BAILY, ESQ., R. M.—*Trelawney Saunders, London*, 1850.

"We are not surprised to find embodied in this map all the territorial pretensions and arbitrary political divisions of the country devised and set up by the British government. A few strokes of the colorist's brush have been sufficient to indicate British sovereignty over two-thirds of the Department of Vera Paz in Guatemala, to convert the islands belonging to Honduras, in the bay of the same name, into British dependencies, and to carry Mosquito jurisdiction over more than half of the respective states of Honduras and Nicaragua. Nor has it been less potent in settling the question of boundary between Nicaragua and Costa Rica in favor of the latter state, in which, by a singular coincidence, British influence has always predominated! These peculiarities of the map, in view of its origin, can hardly be regarded as surprising. Those who constructed it have probably smiled to know with what ignorant servility it has been copied on this side of the Atlantic.

"It may nevertheless be said of this map that it is the nearest approximation to accuracy which has yet been published. Still, in many important geographical as well as political features it is deficient, and in others totally wrong. Leaving out of view both Guatemala and Costa Rica, we find a number of most important errors in the remaining states, which appear all the more surprising, since Mr. Baily not only resided for many years in Central America, but must have travelled over a great part of its territories."

This extract is a sufficient clue to the political tendencies of the work, in so far as it bears on questions in dispute between the British and American Governments, and these must be borne in remembrance in studying its contributions to our geographical knowledge of the country, furnished by Mr. Squier, with the aid of large and well executed maps. After making all allowance, however, for the bias so unmistakeably influencing the American Chargé d'Affaires in relation to every thing in which Britain can be supposed to have the remotest interest, the contributions to our geographical knowledge of the important district referred to are interesting and valuable; and the more so as the authorities for many of the details are supplied, and their relative trustworthiness is accordingly patent to all. In the map of Honduras and San Salvador, for example, we learn that the leading points on the proposed line of railway were determined by Lieutenant Jeffers from numerous and careful astronomical observations; and these constitute the basis on which the details within their range are calculated. "These calculations are entitled to additional confidence from the circumstance that there are, both in Honduras and San Salvador, a number of elevated and commanding mountain and volcanic peaks, which are almost constantly kept in view by the traveller, and always enable him to determine his position

with considerable accuracy." The bearings of these points have accordingly constituted important fixed data, in so far as they applied. Much, however, still remains, "inserted on the best information that could be obtained, and *in a few instances conjecturally*. The course of the Rio Patuca, and the relative positions of the towns situated on its upper waters, are on the authority of a rude map constructed by the mahogany-cutters who are established on the Patuca River and its tributaries." Other important areas are laid down in like manner, from data furnished by native maps; and how far these are to be relied on for minute accuracy may be guessed by the admission that "little reliance can be placed upon the *Itinerários* which are appended to the various *Calendários* published in Central America in respect of distances. The computations are in leagues, and have been obtained chiefly from the professional *arrieros*, or muleteers of the country, whose estimates of distances are very loose, depending, as they often naively confess; upon *the qualities of their mules!*" And as it would seem that the rate of the arriero's mule has been assumed as the measure of the league in horizontal distance, alike over level ground and broken and mountainous districts, such as abound in the country, the precise value of the results, it is obvious, must present a vague and very variable approximation to the truth.

Both the Geology and the Natural History of Central America receive the attention of the observant author in the course of his work, and owing to the volcanic character of that portion of the American continent, some of his descriptions of the scenery, and his notices of volcanic phenomena, have a special interest. On this subject the following extract will furnish a good example of his style of treatment of such themes:

"The volcanic features of San Salvador are both numerous and striking. Only two of the eleven great volcanoes of the state are what are called "vivo," alive or active, viz., San Miguel and Izalco. The first named rises sheer from the plain to the height of six thousand feet, in the form of a regular truncated cone. It emits constantly great volumes of smoke from its summit, but its eruptions have been confined, since the historical period, to the opening of great fissures in its sides, from which have flowed currents of lava, reaching, in some instances, for a number of miles. The last eruption of this kind occurred in 1848, but it resulted in no serious damage.

"It is difficult to conceive a grander natural object than this volcano. Its base is shrouded in densest green, blending with the lighter hues of the grasses which succeed the forest. Above these the various colors melt imperceptibly into each other. First comes the rich umber of the scoriæ, and then the silver tint of the newly-fallen ashes at the summit; and still above all, floating in heavy opalescent volumes, or rising like a plume to heaven, is the smoke, which rolls up eternally from its incandescent depths.

"The volcano of Izalco may, however, be regarded as the most interesting volcanic feature of the state. This volcano and that of Jorullo, in Mexico, described by Humboldt, are, I believe, the only ones which have originated on this continent since the discovery. It arose from the plain, near the great mass of the extinct volcano of Santa Anna, in 1770, and covers what was then a fine cattle hacienda or estate. About the close of 1769 the dwellers on this estate were alarmed by subterranean noises and shocks of earthquakes, which continued to increase in loudness and strength until the twenty-third of February following, when the earth opened about half a mile from the dwellings on the estate, sending out lava, accompanied by fire and smoke. The inhabitants fled, but the *vaqueros* or herdsmen, who visited the estate daily, reported a constant increase in the smoke and flame, and that the ejection of lava was at times suspended, and vast quantities of ashes, cinders, and stones sent out instead, forming an increasing cone around the vent or crater. This process was repeated for a long period, but for many years the volcano has thrown out no lava. It has, however, remained in a state of constant eruption, and received, in consequence, the designation of "El Faro del Salvador," the Light-house of Salvador. Its explosions occur with great regularity, at intervals of from ten to twenty minutes, with a noise like the discharge of a park of artillery, accompanied with a dense smoke, and a cloud of ashes and stones which fall upon every side, and add to the height of the cone, which is now about twenty-five hundred feet in altitude.

"The volcanoes of San Vicente and Tecapa have several orifices or vents, emitting smoke, steam, and sulphurous vapors, which are called "*Infernillos*," literally "Little Hells." In a word, it may be said, with truth, that San Salvador comprehends more volcanoes, and has within its limits more marked results of volcanic action, than probably any other equal extent of the earth. For days the traveller within its borders journeys over unbroken beds of lava, scoriæ, and volcanic sand, constituting, contrary to what most people would suppose, a soil of unbounded fertility, and densely covered with vegetation."

In many respects this region of Central America resembles the fair deceitful Italian fields, surrounding the classic crater of Vesuvius, and like them too, it has its buried Pompeii: the city of San Salvador, reared on a table land wholly made up of scoriæ, volcanic ashes, and fragments of pumice, overlying to the depth of hundreds of feet, the beds of lava which had flowed from the volcano before their ejection. The great volcano of "Our Saviour," as it is oddly enough named, rears its cone about three miles to the westward of the ruined city, to a height of about eight thousand feet, while beneath it, at a much lower altitude, is the jagged mouth of the crater, yawning its huge jaws, it is said, a league and half in circumference and nearly three thousand feet deep. Such is the chief central object of the region originally chosen as the site for the capital of the republic of San Salvador. The hills around the plain of the same name are covered with verdure, and the loose, but fertilising volcanic soil adds some other singular features to the locality.

"Those who have seen the scoriaceous beds which cover Pompeii can form an accurate idea of the soil on which San Salvador was built. The channels of the streams are worn down to a great depth through this light and yielding material, and constitute immense ravines, which render the approaches to the town almost impassable, except at the places where graded passages are cut down on either side paved with stone, and sometimes walled, to keep them from washing out and becoming useless. Some of these approaches are so narrow that it is customary, when mounted, to shout loudly on entering, so as to avoid encountering horsemen in the passages, which are frequently so restricted as to preclude either passing or turning back. San Salvador has more than once owed its safety in time of war, to these natural fortifications, which confounded the enemy with their intricacies and difficulties, while affording means of defense to the inhabitants.

"The facility with which the soil above described washes away has been the cause of several disasters to San Salvador. During a heavy rain of several days' duration, called a '*Temporal*,' which occurred in 1852, not only were all the bridges which crossed a small stream flowing through one of the suburbs of the town undermined and ruined, but many houses destroyed in the same manner. One of the principal streets, extending into the suburbs, began to wash at its lower extremity, and the excavation went on so rapidly that no effort could arrest it. A considerable part of the street became converted into a huge ravine, into which the houses and gardens on either side were precipitated. The extension of the damage was guarded against, when the rain ceased, by the construction of heavy walls of masonry, like the faces of a fortification. How serious an undertaking this was regarded may be inferred from the fact that its completion was deemed of sufficient importance to be announced in the annual message of the President.

"San Salvador, like all other Spanish towns, covered a large area in proportion to its population. The houses were built low, none being of more than one story, with very thick walls, designed to resist the shocks of earthquakes. Each was built around an inner court, planted with trees and flowers, and frequently containing a fountain. To the circumstance of the existence of these courts the people of San Salvador owe their general preservation in the late catastrophe. They afforded ready and secure places of refuge from the falling dwellings.

The population of San Salvador was estimated in 1852 at twenty-five thousand. Including the little towns in its environs and which were practically a part of it, such as Soyopango, San Marcos, Mexicanos, etc., its inhabitants might have been estimated at thirty thousand. It was the seat of a bishopric, with a large and beautiful cathedral church, and of a large and flourishing university, the buildings for which were only finished about a year ago. It had also a female seminary, several hospitals, and numbered some eight or ten churches. In 1852, a very large and beautiful cemetery, with a fine facade and dependent chapels, was constructed. Two aqueducts, one of which is five miles in length, supplied the city with water. It was also a place of considerable and improving trade. Under the auspices of the late president, Duenas, a cart-road was surveyed, and carried nearly, if not quite, to a successful conclusion, from the city to its port on the Pacific, called La Libertad, a distance of about twenty-two miles. This, in a country where the best roads are hardly equal to what we would here call cattle-paths, was certainly no inconsiderable advance.

"The market of San Salvador was well supplied from the numerous Indian villages around it. On feast-days, and on the occasion of the fairs, such as that

falling on the anniversary of the victory of Alvarado, the town overflowed, not only with people gathered from within a radius of fifty leagues, but with foreigners and merchants from every part of Central America. At these fairs the accounts between dealers were adjusted, and contracts, sales, and purchases made for the ensuing year; the whole concurrence and bustle contrasting strangely with the usual monotony and quiet.

"With the exception of the central and paved part of the city, San Salvador was eminently sylvan, being literally embowered in tropical fruit-trees. The red-roofed dwellings, closely shut in with evergreen hedges of cactus, shadowed over by palm and orange-trees, with a dense background of broad-leaved plaintains, almost sinking beneath their heavy clusters of golden fruit, were singularly picturesque and beautiful. In recalling the picture, it is sad to think that all is now abandoned and desolote; that the great square is deserted, and that a silence, unbroken even by the fall of water from the lately glittering fountains, reigns over the ruined and deserted, but once busy and beautiful city of 'Our Saviour'!"

The treacherous nature of the site, that tempted by its fertile soil, the builders of the Capital to rear a City characterised by so many features of utility and beauty, in the vicinity of the "living" volcano, was evinced by repeated shocks of earthquakes in the sixteenth and seventeenth centuries, as well as by one in 1839, which did such damage to the city as then to lead many to think of abandoning it. A more dreadful manifestation of the power of the destroyer, however, was needed, before the people were at length affected by a terror sufficiently profound to overcome all the strength of local attachment and vested interests, and compel them to resolve on seeking a safer site whereon to found a new Capital, in imitation of the example of the citizens of Guatemala: originally built at a place now called the Antigua, or Old City. The earthquake which destroyed the city of San Salvador took place so recently as the month of April, 1854; and by a succession of sudden and terrific shocks, lasting altogether no more than ten seconds, levelled the entire city in ruins. The following contemporary account of this fearful catastrophe is derived from the *Boletin Extraordinaries del Gobierno del Salvador*, published only about a fortnight after the event which it records. The festival of Easter fell in that year on the 16th of April, and it was immediately after the celebration of Easter Sunday's commemorative services, associated with the miraculous passing of the destroyer over the ancient cities of the Nile, when all the first born of Egypt perished, that sudden destruction came on the long threatened Capital of San Salvador. The style of the bulletin which records this terrible catastrophe partakes in no degree, it will be seen, of the dry formality which we are accustomed to in such official documents.

"The night of the 16th of April, 1854, will ever be one of sad and bitter memory for the people of Salvador. On that unfortunate night, our happy and beautiful

capital was made a heap of ruins. Movements of the earth were felt on the morning of Holy Thursday, preceded by sounds like the rolling of heavy artillery over pavements, and like distant thunder. The people were a little alarmed in consequence of this phenomenon, but it did not prevent them from meeting in the churches to celebrate the solemnities of the day. On Saturday all was quiet, and confidence was restored. The people of the neighborhood assembled as usual to celebrate the Passover. The night of Saturday was tranquil, as was also the whole of Sunday. The heat, it is true, was considerable, but the atmosphere was calm and serene. For the first three hours of the evening nothing unusual occurred, but at half-past nine a severe shock of an earthquake, occurring without the usual preliminary noises, alarmed the whole city. Many families left their houses and made encampments in the public squares, while others prepared to pass the night in their respective court-yards.

"Finally, at ten minutes to eleven, without premonition of any kind, the earth began to heave and tremble with such fearful force that in ten seconds the entire city was prostrated. The crashing of houses and churches stunned the ears of the terrified inhabitants, while a cloud of dust from the falling ruins enveloped them in a pall of impenetrable darkness. Not a drop of water could be got to relieve the half-choked and suffocating, for the wells and fountains were filled up or made dry. The clock tower of the cathedral carried a great part of that edifice with it in its fall. The towers of the church of San Francisco crushed the episcopal oratory and part of the palace. The church of Santo Domingo was buried beneath its towers, and the college of the Assumption was entirely ruined. The new and beautiful edifice of the University was demolished. The church of the Merced separated in the centre, and its walls fell outward to the ground. Of the private houses a few were left standing, but all were rendered uninhabitable. It is worthy of remark that the walls left standing are old ones; all those of modern construction have fallen. The public edifices of the government and city shared the common destruction.

"The devastation was effected, as we have said, in the first ten seconds; for, although the succeeding shocks were tremendous, and accompanied by fearful rumblings beneath our feet, they had compartively trifling results, for the reason that the first had left but little for their ravages.

"Solemn and terrible was the picture presented on the dark, funereal night, of a whole people clustering in the plazas, and on their knees crying with loud voices to Heaven for mercy, or in agonizing accents calling for their children and friends, whom they believed to be buried beneath the ruins! A heaven opaque and ominous; a movement of the earth rapid and unequal, causing a terror indescribable; an intense sulphurous odor filling the atmosphere, and indicating an approaching eruption of the volcano; streets filled with ruins, or overhung by threatening walls; a suffocating cloud of dust, almost rendering respiration impossible—such was the spectacle presented by the unhappy city on that memorable and awful night!

"A hundred boys were shut up in the college, many invalids crowded the hospitals, and the barracks were full of soldiers. The sense of the catastrophe which must have befallen them gave poignancy to the first moments of reflection after the earthquake was over. It was believed that at least a fourth part of the inhabitants had been buried beneath the ruins. The members of the government, however, hastened to ascertain, as far as practicable, the extent of the catastrophe, and to quiet the public mind. It was found that the loss of life had been much less than

was supposed, and it now appears probable that the number of the killed will not exceed one hundred, and of wounded fifty. Among the latter is the bishop, who received a severe blow on the head; the late president, Senior Duenas; a daughter of the president, and the wife of the secretary of the Legislative Chambers, the latterly severely.

"Fortunately, the earthquake has not been followed by rains, which gives an opportunity to disinter the public archives, as also many of the valuables contained in the dwellings of the citizens.

"The movements of the earth still continue, with strong shocks, and the people, fearing a general swallowing up of the site of the city, or that it may be buried under some sudden eruption of the volcano, are hastening away, taking with them their household gods, the sweet memories of their infancy, and their domestic animals, perhaps the only property left for the support of their families, exclaiming with Virgil, '*Nos patriæ fines et dulcia linquimus arva.*'"

The peaked and lofty mountain groups already referred to, forming such striking landmarks to the surveyor, have an additional interest in some respects from the extensive evidences of volcanic action which show the process of upheaval still going on throughout a considerable area. Their mineral treasures, too, have long been celebrated. The San Salvador group of silver mines, known under the general name of *Minas de Tabanco*, hold the silver in combination with galena and sulphuret of zinc. They are reported to be easily worked, and to yield from forty-seven to two thousand five hundred and thirty-seven ounces to the ton. Of these the Santa Rosalina mine is the richest, and a considerable part of its ores are shipped direct to England. Rich mines of iron also produce a metal of great value, and easily wrought. The ore is found near the surface, in great abundance, and extensive forests in its immediate vicinity supply the means for making charcoal. Mr. Baily, whose geographical labours, as we have seen, come under the censure of Mr. Squier from their supposed exaggeration of British rights, states that some of this iron, from the mines near the village of Petapa, was sent to England a few years ago for the purpose of examination, and proved to be a "very valuable variety for conversion into fine steel, approaching in this respect very nearly to the celebrated *wootz* of India." But of still more practical interest than any other of its mineral treasures, is its coal, to which Mr. Squier specially directed his attention, and he here communicates the results of his observations:

"Among the many undeveloped resources of San Salvador, and one which may perhaps come to have a first value in the state, is its coal, of which there is reason for believing vast beds exist throughout the valley of the Rio Lempa, and in the valleys of some of its principal tributaries, over a region of country one hundred miles long by not far from twenty miles broad. Coal had long been reported to exist in the state, previously to my visit in 1853. The investigations which were then

made, under my directions, may, however, be regarded as having put the question at rest. Coal was found at a number of places in the valley of the Rio Titiguapa, flowing into the Lempa from the west, of good quality, proper geological conditions and with every indication of abundance. This river, it may be observed, is navigable for seven months in the year. The coal occurs about two leagues above its junction with the Lempa; also in the valley of the Rio Torola, about three leagues from its junction with the Lempa, of good quality, apparently abundant, and having all the geological conditions perfect. Near the town of Hobasco, close to the Rio Lempa, it is reported to exist in large beds, and to have been used for many years by the village smiths.

The coal of San Salvador is all of the variety called *brown coal*, and is a later formation than what is known as *pit* coal. In Germany it is found in vast deposits in Croatia, Moravia, Bohemia, Tyrol, Saxony, Silesia, etc., and it is worthy of remark that all the coal which has been found south of the Mississippi Valley, in Mexico, Central America, New Granada, Chili, etc., appears to be of this variety. In the county of Mansfeldt, in Germany, the brown coal is used for toughening copper, and for melting the white metal for the blue metal in reverberating furnaces. All the steam-engines in the above named German coal districts are fed with this coal. It can be used for refining lead and silver, for the calcination of ores, and generally for all the operations performed in reverberatory furnaces. Trials which have hitherto been made to coke it, for use in blast furnaces, have not been successful. I am not aware that its use has ever been attempted for locomotives and steam ships. This is not remarkable, as it has hitherto been found where no opportunity has existed of submitting it to this kind of trial. That found in the valley of Rio Titiguapa, already alluded to, has a specific gravity of 1.57; ashes 10.5 per cent. It is of that peculiar kind of brown coal called *pitch coal*, and is rich in bitumen."

In these notices we have devoted the largest share of attention to San Salvador, which, though the smallest of the Central American States, is in many respects the most remarkable. It has relatively the most numerous population, and surpasses all the other States in industry and extent of commerce. But there is another subject, relating to the whole region of Central America, in reference to its varied population, which has specially engaged Mr. Squier's attention, and to which we shall devote the remainder of our space. There is a disposition apparent on the part of the author to disparage the Mosquito population, such as we can scarcely avoid ascribing fully as much to political as to ethnological grounds. But, making allowance for this, the following generalization is of considerable value:

"The area of Central America may be calculated, in round numbers, at 155,000 square miles—very nearly equal to that of the New England and the Middle States combined. The population may be estimated at not far from 2,000,000, of which Guatemala has 850,000; San Salvador, 394,000; Honduras, 250,000; Nicaragua, 300,000; and Costa Rica, 125,000.

The geographical and topographical features of all countries have had, and always must have, an important and often a controlling influence upon the character and

destiny of their populations. The nature and extent of this influence receives a striking illustration both in the past and the present condition of Central America. At the period of the discovery, it was found in the occupation of two families of men, presenting in respect to each other the strongest points of contrast. Upon the high plateaus of the interior of the country, and upon the Pacific declivity of the continent, where the rains are comparatively light, the country open, and the climate relatively cool and salubrious, were found great and populous nations, far advanced in civilization, and maintaining a systematized religious and civil organization. Upon the Atlantic declivity, on the other hand, among dense forests, nourished by constant rains into rank vigor, on low coasts, where marshes and lagoons, sweltering under a fierce sun, generated deadly miasmatic damps, were found savage tribes of men, without fixed abodes, living upon the natural fruits of the earth, and the precarious supplies of fishing and the chase, without religion, and with scarcely a semblance of social or political establishments.

It is impossible to resist the conviction that the contrasting conditions of these two great families were principally due to the equally contrasting physical conditions of their respective countries. With the primitive dweller on the Atlantic declivity of Central America, no considerable advance, beyond the rudest habits of life, was possible. He was powerless against the exuberant vitality of savage nature, which even the civilized man, with all the appliances that intelligence has gradually called to his aid, is unable to subdue, and which still retains its ancient dominion over the broad alluvions, both of Central and South America. His means of sustenance were too few and too precarious to admit of his making permanent establishments, which, in turn, would involve an adjustment of the relations of men and the organization of society. He was therefore a hunter from necessity, nomadic in his habits, and obliged to dispute his life with men who, like himself, were scarcely less savage than the beasts of the forests.

Civilization could never have been developed under such adverse conditions. It could only originate where favorable physical circumstances afforded to man some relief from the pressure of immediate and ever recurring wants—where a genial climate, and an easily-cultivated soil, bountiful in indigenous fruits, would enable him not only to make his permanent abode, but to devote a portion of his time to the improvements of his superior nature.

Such were the circumstances which surrounded the dweller on the high plains of Honduras and Guatemala. There, wide and fertile savannas invited to agriculture, and yielded to the rudest implements of cultivation an ample harvest. The maize, that great support of aboriginal civilization in America, was probably indigenous there, and was thence carried northward over Mexico and the Floridas by the various families who established themselves in those regions, and whose languages and traditions point to the plateaus of Guatemala as their original seat.

The natural conditions which favored the development of mankind in one portion of Central America, and rigidly suppressed it in another, are still active and potential. The Spaniards stopped not to maintain an unequal struggle against savage nature on the Atlantic slope of the continent, but established themselves upon the dryer, more salubrious, and more genial Pacific declivity. The Mosquito Shore still remains the haunt of savages, whom three hundred years of contact with civilization have failed to improve; while the State of San Salvador sustains a population twice as great in proportion to its area as any other equal extent of Spanish America, and relatively as great as that of New England itself.

These natural conditions will continue to foster settlement and population on the one hand, and discourage and oppose it on the other; and not until those portions of Central and South America which are most favored in respect of position and climate are filled to overflowing, and the progress of discovery, both in science and art, has invested men with augmented ability to combat successfully the diseases and physical difficulties which exist in the valleys of the Amazon and Orinoco, and on the Mosquito Shore, will those regions be submitted to the influences of civilization, or become the seats of any considerable populations.

The natural relations of Central America, as indicated by the physical facts already pointed out, are clearly with the Pacific and the states which now exist or may spring into existence upon that coast. To California and the greater part of Mexico, as also to some of the states of South America, it must come sooner or later, to sustain a position corresponding with that which the West Indies have held toward the United States and Europe, with the important addition of being an established route of travel, and perhaps ultimately of commerce, between the eastern and western hemispheres. Its destiny is plainly written in the outlines of its coast, and is printed on its surface, not less than demonstrated by its geographical position."

The whole of the third chapter is devoted to the question of population, and embodies much valuable information, derived from official documents, statistical tables and various other sources of information, supplemented by the author's own peculiar views and critical deductions. From this, as well as some later pages of the volume referring to the same subject, we shall make some extracts:

"Mr. Thompson who was British commissioner to the old Federation of Central America in 1823, estimated the relative proportions of the people as follows:

Whites and Creoles	One fifth.
Mixed Classes	Two fifths.
Indians	Two fifths.

He estimates the Europeans, 'or perfect whites,' at not more than 5000. Mr. Crowe, referring specially to Guatemala, calculates the proportions as follows:

Indians	Three fifths.
Ladinos	One fourth.
Whites	One fortieth.
Mulattoes	One eightieth.
Negroes	One fiftieth.
Sambos	One hundredth.

Ladinos, it may be observed, is a term signifying gallant men, and is understood to apply to the descendants of whites and Indians. It is only used in Central America.

The following Table probably exhibits very nearly the exact proportions in Central America, so far as they may be deduced from existing data and from personal observation:

Whites	100,000
Mixed	800,000
Negroes	10,000
Indians	1,109,000
Total	2,019,000

From the foregoing facts and observations, it may be deduced generally that Central America is relatively the most populous portion of Spanish America; that while its population is increasing in a constant and rapid ratio, the exotic or European element is not only decreasing relatively, but in fact; and that the direct tendency of things is to its speedy absorption in the indigenous or aboriginal races. In this respect, as indeed in its moral and intellectual condition, Central America, not less than all Spanish America, seems to furnish a striking illustration of the laws which have been established as the results of anthropological inquiries during the past fifty years. Neither the statesman nor the political economist can safely overlook or disregard these results, since by the course of events, and the multiplication of means and facilities of communication, nations and races are more and more brought in contact, and the question of the nature and character of their relationship made of immediate and practical importance.

It may be claimed without hesitation that the wide physical, intellectual and moral differences which all history and observation have distinguished as existing between the various families of man, can be no longer regarded as the consequences of accident or circumstances; that is to say, it has come to be understood that their physical, moral, and intellectual traits are radical and permanent, and that there can be no admixture of widely-separated families, or of superior with inferior races, which can be harmonious, or otherwise than disastrous in its consequences. Anthropological science has determined the existence of two laws of vital importance in their application to men and nations:

First. That in all cases where a free amalgamation takes place between two different stocks, unrestrained by what is sometimes called prejudice, but which is, in fact, a natural instinct, the result is the final and absolute absorption of one in the other. This absorption is more rapid as the races or families thus brought in contact approximate in type, and in proportion as one or the other preponderates in numbers; that is to say, Nature perpetuates no human hybrids, as, for instance, a permanent race of mulattoes.

Second. That all violations of the natural distinctions of race, or of those instincts which were designed to perpetuate the superior races in their purity, invariably entail the most deplorable results, affecting the bodies, intellects, and moral perceptions of the nations who are thus blind to the wise designs of Nature, and unmindful of her laws. In other words, the offspring of such combinations or amalgamations are not only generally deficient in physical constitution, in intellect, and in moral restraint, but to a degree which often contrasts unfavorably with any of the original stocks.

In no respect are these deficiencies more obvious than in matters affecting government. We need only point to the anarchical states of Spanish America to verify the truth of the propositions here laid down. In Central and South America, and Mexico, we find a people not only demoralized from the unrestrained association of different races, but also the superior stocks becoming gradually absorbed in the lower, and their institutions disappearing under the relative barbarism of which the latter are the exponents. If existing causes and conditions continue to operate, many years can not pass before some of these countries will have relapsed into a state not far removed from that in which they were found at the period of the conquest.

In Mexico there are less than two millions of whites, or of persons having a preponderance of white blood, out of a population of eight millions; in Central Ameri-

ca, less than two hundred thousand out of two millions; and in South America at large, the proportions are nearly the same. It is impossible, while conceding all the influence which can be rationally claimed for other causes, to resist the conviction that the disasters which have befallen those countries are due to a grand practical misconception of the just relations of the races which compose them. The Indian does not possess, still less the South Sea Islander, and least of all the Negro, the capacity to comprehend the principles which enter into the higher order of civil and political organizations. His instincts and his habits are inconsistent with their development, and no degree of education can teach him to understand and practise them"

Here again, we perceive American ideas and prejudices of another kind influencing the deductions of our author. It is difficult indeed for an American, with his Southern helot population, and his Western Red Indian disputants for the soil claimed by the White supplanter, to take an impartial view of ethnological inquiries. The doctrine of the unity of the human race bears to the American no other meaning than this unpalatable one: That the degraded Negro slave and his White oppressor are of one race and of one blood; and hence the confusion of ideas relative to the causes of social and political degradation in Spanish America. But have not the same causes to a great extent produced the like effects in the Spanish mother country, where no such distinctions of race existed to be violated? A reference to Prescott's "Philip the Second,"—a valuable contribution to European History, to which we propose giving the attention it deserves in a future number,—would suffice to show Mr. Squier, that there is little need of any theory of "a practical misconception of the just relations of the races," to account for the degradation either of Spain or her autonomous colonies. In defining the condition of Spain so early as the middle of the sixteenth century, when possessed of resources greatly enlarged, and territory extended by a brilliant career of discovery and conquest, the historian of Philip II., speaks of it as already disclosing "those germs of domestic corruption which gradually led to its dismemberment and decay." And again, after noting the fatal blow to Spanish liberty by the overthrow of the patriots on the memorable field of Villalar, he thus refers to the products of the subsequent political tranquility,—such a tranquility as despotism alone renders compatible with life: "Sheltered from invasion by the barrier of the Pyrenees, her people were allowed to cultivate the arts of peace so long as they did not meddle with politics or religion,—in other words, with the great interests of humanity." Such were the causes which produced in Spain the tranquility and the corruption of death; and all these causes were not less, but more operative in her Colonies, where the corruption of despotism was present, but without its tranquility; and

such arts of peace as could be practised promoted the aggrandisement of individuals only by the impoverishment and decay of the State. No more remarkable problem has ever been worked out in history than that which is now seen in the contrast between the descendants of the indomitable Anglo-Saxon puritans of New England and the Spanish colonists of Central and South America. That we are not ascribing more weight to the influence of prejudices arising from the peculiar social condition of the United States than is justly due in tracing to such, many of the opinions advanced by the Chargé d'Affaires, will, we imagine, be placed beyond doubt by the further deductions drawn from the previous views concerning "inferior races," "amalgamation of different stocks unrestrained by natural instinct," &c. After brief comment on the supposed aptitude of the Sandwich Islanders for civilization and self-government, which our author traces solely to the work of foreigners and white men, he thus proceeds to bring the question home to his own countrymen:

"To the Indians upon our southwestern border these remarks are scarcely less applicable. Under no circumstances have the North American Indians exhibited an appreciation of the value, or a disposition to abide by the reciprocal obligations involved in a government of the people. Their ideas of government, like those of the Arabs, and the nomadic hordes of Central Asia, are only consonant with the system called patriarchal: ideas which, at this day and in this country, are not only wholly inapplicable, but antagonistic to those upon which our system is founded. The only instance in which they have made a sensible progress in the right direction is that of the Cherokees, under the guidance of chiefs in whose veins flows a predominance of European blood. And while it may be admitted that the Indians of the old Floridian stock are in all respects superior to the islanders of the Pacific, yet neither in industry docility, or traditional deference to authority are they equal to the Indian families of Mexico and Central America, where the attempt to put the latter on a political and social footing with the white man has entailed eternal anarchy, and threatens a complete dissolution of the political body.

In Guatemala, as in Yucatan, it has brought about a bloody and cruel war of castes, and in the former state has resulted in placing a treacherous and unscrupulous half-breed at the head of affairs, who rules over a desolated country with irresponsible sway. Not less disastrous has been the result in Mexico, while in Jamaica savage nature is fast resuming her dominion over deserted plantations, and the woods begin to swarm with half-naked negroes, living upon the indigenous fruits of the soil, and already scarcely one degree removed from their original barbarism in Africa.

To the understanding of intelligent and reflecting men, who are superior to the partisan and sectional issues of the hour, these considerations can not fail to appeal with controlling force; for if the United States, as compared with the Spanish American republics, has achieved an immeasurable advance in all the elements of greatness, that result is eminently due to the rigid and inexorable refusal of the dominant Teutonic stock to debase its blood, impair its intellect, lower its moral standard, or peril its institutions by intermixture with the inferior and subordinate

races of man. In obedience to the ordinances of Heaven, it has rescued half a continent from savage beasts and still more savage men, whose period of existence has terminated, and who must give place to higher organizations and a superior life. Short sighted philanthrophy may lament, and sympathy drop a tear as it looks forward to the total disappearance of the lower forms of humanity, but the laws of Nature are irreversible. *Deus vult*—it is the will of God!'

Deus vult!—The reader will not fail to call to remembrance when this *cri de guerre* was first adopted. *Deus vult!* shouted the crusaders of Western Europe when the first fanatical host prepared to set out for the purpose of exterminating the infidel races of the East, and with like pious consistency the enslaver of the African Negro and the exterminator of the American Indian in our own day, complacently pursue their own selfish ends as the will of God! Apart, however, from subjects which it is difficult for the American diplomatist and politician to view with an impartial eye, the ethnological speculations of our author are well worthy of attention, and have attracted notice in more than one previous work from his pen. In relation to the aboriginal population of San Salvador, he remarks:

"The inquirer into the history and relations of the aborigines of America is often surprised to find enigmatical fragments of the great primitive families of the continent widely separated from their parent stocks, and intruded among nations differing from them in manners, language, government, and religion. These *erratic* fragments —to adopt a geological term—in some instances present the clearest and most indubitable evidences of their origin and relationship, in an almost unchanged language, and in a civil and social organization, manners, and customs, little, if at all, modified from those of their distant progenitors. The inference from this would naturally be that their separation had been comparatively recent; yet these identities have been found to exist in cases where tradition fails to assign a cause or period for the disruption, or even to indicate the manner in which it took place.

At the period of the discovery of America, a colony or fragment of that primitive stock, which, under the name of Quichés, Kekaiquels, Tzendales, Mayas, etc., occupied nearly the whole of what is now Guatemala, Chiapa, and Yucatan, was found established on the River Panuco. They bore the name of Huastecas, and from them had proceeded these beneficent men who carried the arts of civilization and the elements of a mild religion into those regions, where the Acolhuas and Aztecas, or Nahuales, afterwards built up the so-called Mexican empire. It was one of their leaders bearing the hereditary name Quetzalcoatl in the Nahual dialect, and Cuculcan in the Tzendal, who taught the higher arts to the inhabitants of Cholula, and who afterwards returned to the primitive seats of his brothers in the valley of the Usumasinta by way of the isthmus of Coatzacoalcos. The period of this migration to the Panuco dates back beyond the foundation of the principalities of Anahuac, and is anterior to the Tezcucan and Aztec dynasties.

In Central America, on the other hand, two considerable fragments of the true Nahual or Aztec stock were found intruded among the native or original families of that portion of the continent. One of these, as I have shown in my work on Nicaragua, occupied the principal islands in the Lake of Nicaragua, the narrow isthmus which intervenes between that lake and the Pacific, and probably a portion of the

country to the southward as far as the Gulf of Nicoya. Their country was less than a hundred miles long by scarcely twenty-five broad; yet here they preserved the same language and institutions, and practised the same religious rights with the people of the same stock who dwelt more than two thousand miles distant, on the plateaus of Anahuac, from whom they were separated by numerous powerful nations, speaking a different language, and having a distinct organization."

Referring exclusively to the fragment of the Nahual stock in the San Salvador State, the author thus proceeds:

"As a general rule the aboriginal population has been much modified by three centuries of contact with the whites, and an equally long subjugation to the Spanish rule, yet there are towns even in the immediate vicinity of the capital, which have retained to a surprising degree their primitive customs, and in which the aboriginal blood has suffered scarcely any, if indeed the slightest intermixture. In most places, however, the native language has fallen into disuse, or only a few words, which have also been accepted by the whites, are retained. The original names of places, however, have been preserved here with the greatest tenacity, and afford a very sure guide in defining the extent of territory over which the various aboriginal nations were spread.

In the neighborhood of Sonsonate there are several large towns, inhabited almost exclusively by Indians, who also use the national language in ordinary intercourse among themselves. The same is true of some of the towns on the southern flank of the volcano of San Vicente, whose inhabitants, no later than 1832, attempted to reassert their ancient dominion, and exterminate not only the whites, but all who had a trace of European blood in their veins.

There is, nevertheless, one portion of the State of San Salvador where the aborigines have always maintained an almost complete isolation, and where they still retain their original language, and to a great extent, their ancient rites and customs. This district is known as the "*Costa del Balsimo*," or Balsam Coast. It is about fifty miles in length by twenty to twenty-five miles in breadth, lying between La Libertad, the point of the city of San Salvador, and the roadstead of Acajutla, near Sonsonate. This district is entirely occupied by Indians, retaining habits but little changed from what they were at the period of the conquest. It is only traversed by foot-paths so intricate and difficult as to baffle the efforts of the stranger to penetrate its recesses. The difficulty of intercourse is enhanced, if not by the absolute hostility of the Indians themselves, from their dislike to any intrusion on the part of the whites, be they Spaniards or foreigners. I was, however, fortunate in numbering among my warmest friends in Central America two gentlemen, who are the principal purchasers of the celebrated "Balsam of Peru," which is obtained exclusively by these Indians, and constitutes their only article of sale, and sole source of wealth. They not only have an extensive acquaintance with the Indians, but also great influence over them, which was exercised in putting me in relation with some of the more intelligent ones in their visits to the city of San Salvador. I was thus enabled to obtain a vocabulary of their language, which is nearly identical with the ancient Nahual or Mexican."

It appears, however, from further remarks of Mr. Squier, that a greater change has been produced on this remnant of the Aztec stock than the above remarks would lead us to suppose. They have adopted

the Catholic religion, though intruding into its worship many peculiar aboriginal rites. The mechanical arts, moreover, are described as little understood, and the fine arts still less practised, while music is cultivated only as an accessory to the services of the Church. It is obvious, therefore, that like other aboriginal races, their contact with the European has led to the extinction of their own native arts and civilization, without their sharing in the higher civilization of their conquerors. The only title of rank recognised among them is that of "*Alhuales*, only conceded to persons over forty years of age, *who have had charge of the treasure-boxes of their various Saints*, or who have served in some public capacity." And the predominance of the foreign element in its ecclesiastical aspect is apparent throughout.

"Agriculture among them is carried on only to the extent of producing the maize requisite for the year, and nothing more. Their sole wealth consists of their balsam, calculated approximately to amount to twenty thousand pounds annually, and which they sell at four rials, or half a dollar the pound. This, it might be supposed, would gradually place in their hands some property, but it is quite spent in the festivals of the saints, which are rather eating and drinking bouts than sacred feasts."

Added to this, the following description of their physical characteristics suffices to complete the picture of their present condition:

"Physically, these Indians have more angular and severer features than those of the other families of Guatemala and Nicaragua. They are not so symmetrical in form, and are darker in color, more taciturn, and apparently less intelligent. Their women are much smaller than those of the other Indian nations, are generally ugly, and, when old, little short of hideous. Throughout the State they are industrious; and San Salvador, favored generally with a fertile and arable soil, is undoubtedly the best cultivated, as it is the best populated state of Central America."

Our space forbids us following the author further in his interesting inquiries into the diffusion of the Nahual or Aztec stock at the period of the Spanish conquest; but we have produced evidence enough to shew that, while Mr. Squier is an author whose views must be received with caution on all questions where American prejudices or American interests are involved, he has nevertheless produced a work which will be studied with interest by all who have made themselves familiar with his previous contributions to the Archæology and Topography of this continent.

D. W

Esquisse Géologique du Canada. Pour servir à l'intelligence de la carte géologique et de la collection des minéraux envoyées à l'Exposition Universelle de Paris, 1855. Par W. E. Logan et T. Sterry Hunt. Paris, 1855.

This admirable little *brochure*, published in Paris during the Exposition, was drawn up in French by Mr. Hunt, with the co-operation of Sir William Logan, chiefly to serve as a guide to the geological map and collection of mineral products exhibited in the Canadian department. The beautifully executed map, alluded to in the first number of the new series of our Journal, accompanies the volume. A better general view of Canadian geology it is impossible to obtain; and as no other connected view of our geology, beyond a few sketches of very limited extent, has yet been given to the public, we are glad to learn that its re-issue in an English dress may shortly be anticipated. Supplying a long-felt want, in a manner at once clear, accurate, and entirely free from scientific display, it cannot fail to command for itself the most extensive popularity.

The Essay opens with an introductory chapter, chiefly explanatory of the origin and general organization of the Survey, and then proceeds to discuss the various points of interest belonging to the following heads, each of which forms the subject of a separate chapter. (1.) The Laurentine Mountains, and the range of the Laurentian system generally. In a geological aspect, this zone of ancient metamorphic and crystalline rocks divides the Province into two broad districts, north and south: the latter being again subdivided by an anticlinal, running from the Hudson valley and Lake Champlain north-easterly towards Quebec, into an eastern and western basin, each with special characteristics of its own. (2.) The Laurentian system in its mineral and structural details. (3.) The Huronian system, the great copper-bearing region of the west, occupying a vast extent of country along the northern shores of Lake Huron and Lake Superior, and traversed by numerous dykes of trap. (4 and 5.) The Palæozoic rocks of the western basin, comprising, in an ascending series, the Potsdam sandstone; Calciferous Sand Rock; the Chazy, Bird's-eye, Black River and Trenton limestones: in places so rich in fossils; the Utica schist, with its peculiar trilobites; the Hudson River group; the Medina sandstone, or base of the Upper Silurians; the Clinton group; Niagara limestone; Onondaga salt group, with its gypsum beds and brine springs; and finally the Devonian formations, comprising portions of the Helderberg series*,

* The Oriskany sandstone and Corniferous limestone equivalents. The former feebly represented.

and the Hamilton shales: the latter with their petroleum springs and asphalt deposits. (6 and 7.) The Eastern basin, comprising various formations of the Lower and Upper Silurian series, including the Sillery group of conglomerates and graptolitic schists, unknown in Western Canada. In its geological position this band is intermediate between the Hudson River group and the Medina sandstone. The eastern basin includes also the Devonian and Lower carboniferous beds of Gaspé; and offers in its lines of disturbance and very generally metamorphosed condition, a remarkable contrast to the Western District. The metamorphic rocks of this division are discussed in detail in chapter 7, one of the most interesting in the volume. Chapters 8, 9 and 10, treat respectively of the post-tertiary and alluvial deposits, the mineral springs, and the great basin of the North. It may be remembered, with regard to the latter, that the results of the survey have shewn the absence of Lower Silurian strata apparently along the entire district: and hence the inference of Sir William Logan, that the southern boundary of the Laurentian range, from Labrador to the Arctic Ocean, formed the limiting shore-line of a Lower Silurian sea.

It was our intention to have presented to the readers of the Journal, a condensed translation of this most useful little work; but finding that an English edition, from the pen of Professor Hunt, is shortly to appear, we have confined ourselves, in the present notice of the publication, to a simple announcement of its contents.

The volume concludes with a classified list of the economic minerals of Canada, and of their respective special localities: forming a complete index to our mineral wealth. The Geological Commission would confer no common benefit upon the public, by re-issuing at once this latter part of the work, both in French and English, and causing its general circulation throughout the Province.

E. J. C.

Philosophy of Sir William Hamilton, Bart., Professor of Logic and Metaphysics in Edinburgh University, arranged and edited by O. W. Wight, Translator of Cousin's "History of Modern Philosophy." New York: D. Appleton & Co., 1853.*

We do not intend at present to enter into a formal and complete review of Sir William Hamilton's Philosophy, to which the title of

* The substance of the following review was originally produced in the form of a communication read before the Canadian Institute, 9th February, 1856, under the title of "Brief Notes on certain statements of Sir William Hamilton regarding the validity of our primary Beliefs." The date of that communication will account for its being written without reference to the death of the distinguished philosopher, some of whose opinions are brought under review.

this American publication might tempt us, but merely, by way of note, to advert to certain statements of that distinguished writer regarding the trustworthiness of consciousness: advanced with special reference to the theory of sensitive perception; but which, whether in their bearing on that doctrine, or in their application generally, seem to be open to grave objections. If we should be thought to criticise too severely the statements referred to, our excuse must be the pre-eminence—the deserved pre-eminence—of the philosopher by whom they are made. The mistakes of an ordinary writer might be left unnoticed, or passed lightly over; but should Sir William Hamilton really be in error in what he teaches on the fundamental question of the validity of consciousness, it is of the utmost importance that his error should be pointed out.

In his exposition of the "Philosophy of Common Sense," Sir William, after shewing that our knowledge is not all at second hand, but that some at least of our cognitions must be immediate, proceeds to answer the inquiry how these certify us of their veracity. Is consciousness perfectly trustworthy?

"Limiting, therefore, our consideration to the question of authority: how, it is asked, do these primary propositions—these fundamental facts, feelings, beliefs, certify us of their own veracity? To this the only possible answer is, that as elements of our mental constitution—as the essential conditions of our knowledge—they *must* by us be accepted as true. To suppose their falsehood is to suppose that we are created capable of intelligence, in order to be made the victims of delusion; that God is a deceiver, and the root of our nature a lie. But such a supposition, if gratuitous, is manifestly illegitimate. For, on the contrary, the data of our original consciousness must, it is evident, *in the first instance*, be presumed true. It is only if proved false that their authority can, *in consequence of that proof*, be, *in the second instance*, disallowed."

In another passage, after stating that, "though the veracity of the primary convictions of consciousness must in the outset be admitted, it still remains competent to lead a proof that they are undeserving of credit," Sir William continues:

"But how is this to be done? As the ultimate grounds of knowledge, these convictions cannot be redargued from any higher knowledge; and, as original beliefs, they are paramount in certainty to every derivative assurance. But they are many; they are, in authority, co-ordinate; and their testimony is clear and precise. It is therefore competent for us to view them in co-relation; to compare their declarations; and to consider whether they contradict, and, by contradicting, invalidate each other. This mutual contradiction is possible in two ways. (1.) It may be that *the primary data themselves* are directly or immediately contradictory of each other; (2.) it may be that they are mediately or indirectly contradictory, inasmuch as the *consequences* to which they *necessarily* lead, and for the truth or

falsehood of which they are therefore responsible, are mutually repugnant. By evincing either of these, the veracity of consciousness will be disproved."

"No attempt," it is subsequently remarked, "to shew that the data of consciousness are (either in themselves or in their necessary consequences) mutually contradictory, has yet succeeded; and the presumption in favor of the truth of consciousness and the possibility of philosophy has, therefore, never been redargued."

Now these statements seem to us to open the door to scepticism. For what do they imply? Obviously, that though a denial of the primary data of consciousness involves what is abhorrent to our natural sentiments, and not to be thought of, except under the pressure of a logical necessity, yet there are at least conceivable circumstances in which such a denial would be warrantable. Sir William's doctrine renders it obligatory upon us to hear the pleadings of counsel against consciousness, if any person should come forward, and make affidavit that he can show consciousness to be self-contradictory. But if we can be required, under any pretence whatever, to listen to evidence against our primary beliefs, they cannot be absolutely, infallibly, in the strictest sense of the term, *certain*. Observe the language in which Sir William himself expresses the conclusion that satisfies his mind, and in which he wishes his readers to rest. It is exceedingly (we had almost said *painfully*) significant. "No attempt to shew that the data of consciousness are (either in themselves or in their necessary consequences) mutually contradictory, has yet succeeded; and the presumption in favor of the truth of consciousness and the probability of philosophy has, therefore, never been redargued." The *presumption* in favor of the truth of consciousness! And has it come to this? A presumption! To silence scepticism and render philosophy possible, we must have something more than a presumption—we must have an absolute certainty—of the truth of consciousness.

In most unfortunate consistency with the admission that it is "competent to lead a proof that they (the primary convictions of consciousness) are undeserving of credit," Sir William Hamilton assigns a reason for trusting the deliverances of consciousness. To doubt them would be to suppose that the root of our nature is a lie. Well: a sceptic might rejoin; what then? Be it so. It may be urged that our conceptions of the great Creator forbid us to entertain the thought. God cannot be a deceiver. Is then, we ask, our conviction of the trustworthiness of consciousness dependent on, or capable of deriving support from, the conceptions which we form of the Divine Being? No. The sole guarantee which, in the last anal-

ysis, we have for the validity of the conceptions which we form of the Divine Being, is consciousness itself. And does not a child, who has no idea of the moral attributes of God, believe the intimations of consciousness as firmly and as warrantably as the most enlightened philosopher? Even if the argument derived from the veracity of God be intended simply to corroborate the trustworthiness of consciousness; if Sir William Hamilton mean (as we presume he does) that consciousness certifies us of its own veracity, but that our instinctive persuasion of its truth is fortified by a consideration of what would be involved in its being false, viz., that God would be a deceiver; we are unable to consent to this. We deny that the trustworthiness of consciousness can receive the slightest corroboration from reasoning. A condition of the possibility of any thing being corroborated by argument, is, that it can be argued about. But *in no intelligible sense (as we shall presently endeavor to shew in a particular case) can the veracity of consciousness be even proposed as a question for debate.*

Sir William accepts the deliverances of consciousness "in the first instance." He accepts them, however, with this concession to the sceptic, that, if they should at any time be shewn to be, either in themselves or in their necessary consequences, contradictory, he will give up his faith in them. Now, on the part of consciousness, we protest against any such concession being made to scepticism. Consciousness is injured when we subscribe to its veracity with an *if*. "Your *if*," said Shakspeare, "is a great peace-maker." At times, it is something more. In the case before us it is a traitor who lets the enemy into the fortress. To say that we will regard a man as truthful until he be detected in a falsehood, is virtually admitting that, (much as it would be to our surprise and disappointment), he *may be* guilty of uttering a lie. The principle that consciousness is infallible, is not indeed expressly gainsaid—on the contrary, it is in terms affirmed—by Sir William Hamilton. But that great principle, the recognition of which—as Sir William himself declares—alone renders philosophy possible, is, in our opinion, compromised by his mode of treating the subject. We have an instinctive feeling, he contends, that our primary cognitions are valid. We must begin by accepting them as valid; for otherwise we could not reason at all. It is certainly competent for a sceptic to lead proof to establish the contrary; but no sceptic has ever yet succeeded in such an attempt. Komorn has hitherto maintained, against all assaults, its character of impregnability. This is a comfortable confirmation of our first and natural impressions. The original presumption in favor of consciousness is

strengthened. Our religious nature at the same time comes in to fortify our trust in consciousness. On the supposition that consciousness is not true, God would be a deceiver. Now, is it not palpable that, underlying this whole course of thought, is the silent implied concession, that the truth of our primary cognitions is not, in the strict and absolute sense of the term, certain; but that there is only a vast and incalculable probability, amounting to moral certainty, in favor of their truth? Philosophy, however, is impossible, unless we can vindicate for our primary cognitions, real and absolute, and not merely moral, certainty.

But the question will be put: must we not, even with our absolute faith in the infallibility of consciousness, still allow that its credit would be broken down, if (supposing that possible) it were shewn to be self-contradictory? We answer—and here lies the pith of the whole matter—that the question is absurd. We do not reply with Sir William Hamilton in the affirmative, and say that we would, in the circumstances supposed, give up our trust in consciousness. Neither do we reply in the negative, and say that we would *not* give up our trust in consciousness. We say that the question is absurd. In no intelligible sense (as we previously remarked) can the trustworthiness of consciousness be brought to trial. It is impossible within our present limits to shew this with regard to our primary cognitions at large. It must suffice for us to illustrate our assertion by referring to sensitive perception, the form of consciousness which Sir William Hamilton had specially in view in the statements on which we are commenting.

Sensitive perception is a relation of a certain kind between the *Ego* and the *Non-ego*. What, then, is intended by asking whether consciousness, in revealing the *Ego* and the *Non-ego* in their mutual relation, can be trusted? *The consciousness realized is nothing else than the Ego and the Non-ego existing in relation to one another.* Sir William Hamilton tells us that it is competent for a sceptic to lead proof, and therefore obligatory upon us to listen to his argument in favor of the assertion that consciousness is delusive. But sensitive perception, the consciousness to which our present observations are limited, being a relation, an actual relation, between the *Ego* and the *Non-ego:* to say that it is, or may haply be, found to be delusive, would seem to be equivalent to saying that a subsisting relation is, or may haply be found to be, not a subsisting relation; and before we can consent to hear evidence in support of such a conclusion, we must first be enlightened as to what is meant.

Sir William Hamilton allows that, in one respect, the data of consciousness are, from the very nature of the case, incapable of being canvassed: they are placed "high above the reach of question." But in another respect "they are not.....beyond the possibility of doubt." Were we omitting to notice the distinction referred to —which is held to be important—it might perhaps be thought that we are proceeding upon a mistaken or defective view of the system which we are criticizing. We therefore observe that we are unable to look upon the distinction as well-founded; but that, even were it so, this would not remove our objections to Sir William Hamilton's statements. Sir William shall explain the distinction in his own words. "Here, however, it is proper to take a distinction, the neglect of which has been productive of considerable error and confusion. It is the distinction between the data or deliverances of consciousness considered simply, in themselves, as apprehended facts or actual manifestations, and these deliverances, considered as testimonies to the truth of facts beyond their own phenomenal reality. Viewed under the former limitation they are above all scepticism. But as doubt is in itself only a manifestation of consciousness, it is impossible to doubt that what consciousness manifests, it does manifest, without.....the doubt contradicting, and therefore annihilating itself..... .. Viewed in the latter limitation, the deliverances of consciousness do not thus peremptorily repel even the possibility of doubt. I am conscious, for example, in an act of sensible perception, (1.) of myself the subject knowing; and (2.) of something given as different from myself, the object known. To take the second term of this relation:—That I am conscious in this act of an object given, as a *Non-ego*—that is, as not a modification of my mind—of this, as a phenomenon, doubt is impossible..... It is, however, possible for us to suppose, without our supposition at least being *felo-de-se*, that, though given as a *Non-ego*, this object may, in reality, be only a representation of the *Non-ego*, in and by the *Ego*."

Now, admit this discrimination (if it can be comprehended) and say if it in the least degree blunts the edge of the strictures offered above? In sensitive perception the deliverance of consciousness considered as a testimony to the existence of the *Non-ego*, is not "above all scepticism." It does not "peremptorily repel even the possibility of doubt." The idealist, in denying the existence of an external world, "does not advance a doctrine *ab initio* null." His scepticism is, no doubt, unphilosophical. but why? Because, in the first instance, the data of consciousness must be presumed to be

true. It is only by setting out with this presumption that knowledge is possible. And as it has never yet been shewn that this presumption leads to results contradictory of one another, it follows that "as philosophy now stands," the declarations of consciousness are "entitled to demand prompt and unconditional assent." We are, of course, simply repeating what has been already said, when we charge this doctrine with opening a door to scepticism. Our faith in the existence of a *Non-ego* is nothing better than a "presumption;" a strong presumption, perhaps; but still only a presumption. We have *faith* in the *Non-ego;* but not a *knowledge* of it, in the proper sense of the term. It is within the bounds of possibility, that in *presuming* the *Non-ego* to exist, we are mistaken. Is Sir William Hamilton—the Apostle of Natural Realism—the St. George of Philosophy, whose spear has been thought to have given the death wound to that Dragon of Scepticism which so many valiant knights have assailed in vain—is he himself, after all, chargeable with holding sentiments essentially sceptical?

The distinction to which Sir William Hamilton attaches so much importance, would not remove our objections even if it were admitted; but we are unable to persuade ourselves that it has any foundation. In an act of sensitive perception (it is said) we are conscious of self, the subject knowing; and of something different from self, the object known. Now, let it be understood, that, though a two-fold object may be discriminated in an act of sensitive consciousness, the act itself, the consciousness, is not two-fold, but is single and indivisible. By one indivisible act of consciousness, the *Ego* and the *Non-ego* are apprehended in their mutual relation. The *Ego* is apprehended, not absolutely, but in its relation to the *Non-ego:* the *Non-ego* is apprehended, not absolutely, but in its relation to the *Ego*—the latter apprehension not being a distinct cognitive act from the former, but being identical with it. With this explanation, let us proceed. Our consciousness of the *Non-ego,* Sir William Hamilton tells us, may be viewed in two aspects; first, the consciousness realized may be considered as a phenomenon—in this aspect, doubt regarding it would be suicidal by self-contradiction: secondly, it may be viewed as a testimony to the existence of the *Non-ego*—in this aspect doubt is not peremptorily repelled. But are these aspects, we ask, in reality different? We maintain that they are not. Let us not be led, by mere diversities of expression, to fancy that there are real diversities, where none exist. Is it not a contradiction to speak of two different aspects of consciousness? What is the as-

pect in which we at any moment regard an act of consciousness, but the consciousness of the moment? Logicians may distinguish these things, if they please, but there is no real distinction between them. If so, it follows that two aspects, in reality diverse, in which the consciousness of a particular moment may be viewed, is an absurdity. For, let A be one of these aspects, and B another; C being the indivisible consciousness of the instant. Then A is identical with C; and B is identical with C; so that A and B must be identical with one another. In an act of sensitive perception, the consciousness realized (in whatever aspect, logically speaking, you may choose to view it) is in reality a relation between the *Ego* and the *Non-ego*: it is the *Ego* existing in relation to the *Non-ego*; and as doubt regarding the existence either of the *Ego* or of the *Non-ego*, in a case where a relation is established betwixt the *Ego* and the *Non-ego*, is self-contradictory, it follows that consciousness, not only when considered as a phenomenon (whatever that may signify), but also when regarded as testifying to the existence of Self and Not-self in their mutual relation, is "above all scepticism."

G. P. Y.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

PALÆONTOLOGY OF NEW YORK.

It is universally allowed, that the great work on the Palæontology of the State of New York, by Professor James Hall of Albany, stands pre-eminent amongst the publications of recognised value emanating from American science. The high character, so fully established by the volumes already published, is not without danger, however, of being greatly deteriorated, as regards the completion of the work. It may not be generally known, that the original plan of the publication comprised the issue of five quarto volumes; each to contain about one hundred plates of figures, with appropriate letter-press descriptions. Two of these volumes have already appeared, and a third will be issued early in 1857. Professor Hall has also undertaken, by an agreement entered into between himself on the one part, and the Hon. E. Leavensworth, Secretary of State, and T. Romeyn Beck, Secretary of the Board of Regents, on the other—to devote his entire attention during nine months of each year to the completion of volumes 4 and 5; and to have these ready for press within two periods, each of four years, from the completion of volume 3. So far as we understand the question, an exception seems

to have been taken by some of the Members of the Assembly, on the score of unnecessary expense, to certain details connected with the mode of publication. This appears to have led to the nomination of a select committee, to report upon the matter at issue and on the completion, in general, of the Natural History of the State. The Report of this committee, dated April 8th, 1856, is now before us. It condemns most unequivocally the present system of publication as one of unparalleled extravagance, but on grounds which we believe to be altogether erroneous. The system is to a certain extent, and necessarily, a costly one; but the cost, we repeat, is fully sustained by the character and acknowledged utility of the work. A strong objection is made in the Report to the number of figures or illustrations. Undoubtedly a smaller number might have been given, but with what result—simply the lowering of the work from its present high position to one of comparative mediocrity, alike prejudicial to the reputation of the State from which it emanates, and to the interests of science generally. In many instances, it is only by numerous and varied figures, that the true value of assumed specific or even generic distinctions can be shewn: more especially in the case of fossil specimens, in which distortions and obscurities unavoidably abound. To the earnest student, a single figure, it is well known, is often worse than useless; and we have no doubt that Professor Hall could add, with much benefit to science, many new examples to those already figured in the completed volumes. The Report observes—"The first volume of the Palæontology of New York, describes 381 species, illustrated by 2,000 figures on 100 plates, making the average number to exceed five figures to a species. One thousand figures ought to be regarded by all scientific men, as amply sufficient." Against this judgment we venture without hesitation to protest—knowing full well, that palæontologists, that all indeed who have had anything to do with fossils, will bear us out in our objection. Shackle the author by diminishing the legitimate number of his figures, and the reputation of the work is at once destroyed. We trust, therefore, not only for the sake of American science, but for that of science in general, that the original plan of the publication will be suffered to prevail. A false economy in the present instance, with half the work completed, would be most suicidal in its effects.

ELAPHUS OR CERVUS CANADENSIS.

A large fragment of a right horn belonging to the wapiti, or Canadian stag,* has lately been presented to the Canadian Institute by Mr. T. C. Gregory, resident engineer of the Great Western Railway. It was found imbedded in drift clay, eight feet below the surface of the ground, near the left bank of the River Thames, a few miles from London, C. W. The museum of the Institute possesses a fine and very perfect pair of horns of the same species. The wapiti was formerly abundant in all parts of Canada; and its horns, &c., are of common occurrence in our bogs and marshes. An interesting description of the animal will be found in the second number of the Canadian Naturalist and Geologist.

SUBSIDENCE OF THE NEW JERSEY COAST.

The second Annual Report of the Geological Survey of the State of New Jersey, lately published, contains some exceedingly interesting observations by the Assistant Geologist, George H. Cook, on the rapid encroachment of the sea on the coast line of the State: a phenomenon due in part to the abrading action of the waves, and partly to the actual sinking of the land. Mr. Cook remarks, "While

* Commonly but erroneously called the elk.

in the southern part of the State, my attention was frequently called to the rapid wearing away of the shores, and to the advance of the tide-waters on the land. Local causes were in general assigned for the increased height of the tides; but this and other phenomena were extended over so long a line of shore, that it was thought there must be some general cause for them; and this cause appears to be, the slow but continued settling or subsidence of the land. At the mouth of Dennis Creek, in Cape May county, and for several miles along the bay shore, on each side of it, according to the local surveyors, the marsh wears away, on an average, about one rod in two years; and from the early maps, it would appear to have been going on at that rate ever since the first settlement of the country. A map of Cape May in the possession of Dr. Maurice Beasley of Dennisville, and bearing the date of 1694, lays down Egg Island, the western point of Maurice River Cove, as containing three hundred acres; at low water it now contains a half or three-fourths of an acre, and at high water it is entirely covered. * * * That the tides rise higher upon the uplands than formerly, is the opinion of the oldest observers, upon the Atlantic and Bay Shores, from Great Egg Harbor quite round to Salem Creek. Their opinion is founded on the fact that on the low uplands, or those coming down to the salt marsh with a gentle slope, the salt grass now grows where upland grass formerly grew; and where the land was in wood, narrow fringes of it next the marsh are frequently killed by the salt water, and marsh takes its place. * * In all the salt marshes on the sea shore of southern New Jersey, and also in the salt and fresh tide marshes on Delaware Bay and River, stumps of trees, of the common species of the country, are found with their roots still fast in the solid ground at the bottom of the marsh, and this at depths far below low-water mark. The fact is known to every one living in the neighborhood of these marshes, and the evidence of it can be seen in the bottoms or in the banks of every ditch that is cut in them." Our space will not admit of further extracts, but the entire Report will well repay perusal. A subsidence of the land appears to have taken place, within comparatively modern periods, if it be not still going on, along the greater portion of the Atlantic coast of the Union, as well as in Nova Scotia and Newfoundland. Instances of submarine forests on the shores of Nova Scotia are cited with full details, in Professor Dawson's work on "Acadian Geology," reviewed in a late number of the Journal.

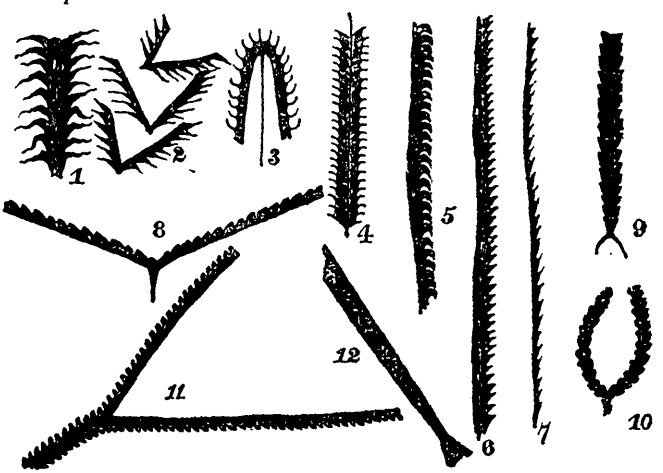
GRAPTOLITES.

The subjoined tabular distribution (with accompanying figures) of the more common forms of American graptolites, may not be unacceptable to some of the readers of the Canadian Journal. For the benefit of the general reader, it may be briefly stated, that the graptolites—confined entirely to the earliest fossiliferous periods of geological history—belonged, in all probability, to the Bryoza: a group of delicate compound, or coral-like forms, ranging at the base of the Molluscous types.* The Bryoza secrete a horny or semi-calcareous framework or common

* The writer has placed in the collection of the Canadian Institute several specimens of modern Bryoza (or of their skeletons rather), obtained by him on the south-eastern coast of England. Some of these have the most striking resemblance to graptolite forms. At the same time, a palæontological law, of very general application, would appear to oppose itself to the idea of even a generic relationship. This law assumes, that after a type has once appeared, it continues through all the intervening periods up to the date of its final extinction. The graptolites are altogether unknown above the lower or middle part of the Upper Silurians.

skeleton; and occur either free, or as an incrustation on stones, shells, sea weeds, and other bodies. The common form of the graptolite is that of an extremely narrow band, dentated or toothed on one or on both of its edges. The so called teeth constitute the cells or dwelling chambers of the separate animals (or vital centres) of the organized mass. The band itself, or stipe, is occasionally expanded into a leaf-like form; or narrowed, on the other hand, into a mere thread. Many specimens exhibit also a filiform central axis, often extending beyond the stipe.

These fossils have been grouped in several genera, of which the more important comprise:—*Graptolithus* (teeth on one side only, but close together, stipe unbranched). *Rastrites* (teeth far apart; stipe unbranched, but often convoluted). *Didymograpsus* (teeth on one side; stipe branched). *Diplograpsus* (teeth on each side of stipe). Certain branched forms, however, have a single row of teeth on the branches, whilst the main stem is toothed on both sides: and hence, in cases of this kind, fragments of one and the same form might be referred to different genera. The deeply recurved species of *Didymograpsus*, again, constitute transitional forms between that genus and *Diplograpsus*. The non-occurrence of doubly-toothed forms, as pointed out by Sir Roderick Murchison, in the Upper Silurians of England, does not militate against these objections: because, (so far as regards species) graptolites are never abundant in these upper rocks, and doubly-toothed species are found in them in other localities. There can be no doubt, moreover, as shewn by Sir W. Logan's discovery in the Point Levi district, that our common specimens exhibit merely a fragmentary condition of the original graptolite structure. The genus *Rastrites* does not appear to have been discovered in America. The other genera are included in this note, under the common term of *Graptolithus*.



§ 1. *Graptolites with mucronate serratures.*

G. mucronatus, Hall. Unbranched; flattened; doubly-toothed; teeth with mucronate and more or less wavy tips. Fig. 1. Hudson River group: Albany.

G. sextans, Hall. Branched; the branches separating from the base, and exhibiting teeth on the outside only; tips delicately mucronate, but often badly preserved. Fig. 2. Hudson River group.

G. caduceus, (*Didymograpsus caduceus*, Salter). Branched; the branches deeply recurved, and toothed on the outside. Long filiform rachis. Fig. 3. Sillery formation; opposite Quebec.

To this section belong also the European forms—*G. Sedgwickii*, Portlock; *G. (Diplograpsus) folium*, etc.

§ 2. *Graptolites with acute or sub-mucronate serratures.*

G. pristis, Hall. (*Diplograpsus pristis*, *Prionotis pristis*, Hisinger). Unbranched. Stipe with central filiform rachis, and teeth on each side; the tips sometimes sub-mucronate. Fig. 4. Trenton limestone, Utica slate, and Hudson River group. *G. amplexicaule* and *G. secalinus*, Hall, are probably varieties.

G. priodon, Bronn. *G. Ludensis*, Murchison: Silurian system. *G. Clintonensis*, Hall). Unbranched; toothed on one side only. Teeth deeply cut, and with recurved tips. Fig. 5. Clinton group. In Europe, in Lower and Upper Silurians.

G. sagittarius, Portlock. Unbranched. Stipe in long narrow pieces, straight or slightly flexuous, with acute teeth on one side only. Fig. 6. Hudson River group.

G. tenuis, Portlock. Unbranched. Stipe in long thread-like pieces, straight or flexuous, obscurely and distantly toothed on one side only. Fig. 7. Hudson River group.

G. serratulus, Hall. Branched: the branches widley divergent, very slender, and with somewhat distant teeth. Fig. 8. Hudson River group, Albany.

G. gracilis, Hall. In delicate, wavy branches. See Pal. New York; vol. 1, p. 274.

G. venosus, Hall. See Pal. New York; vol. 2, p. 40.

§ 3. *Graptolites with obtuse serratures.*

G. bicornis, Hall. Unbranched. Stipe tapering towards the base, and terminating in a short fork. Toothed on each side: teeth obtuse. Central rachis usually well pronounced. Fig. 9. Hudson River group.

G. furcatus, Hall. Branched: the branches near together and converging; bluntly toothed, in general, on both sides. Fig. 10. Hudson River group, Albany.

G. ramosus, Hall. Branched: the branches diverging at a moderate angle, long, and toothed on the outside only. Fig. 11. Hudson River group.

§ 4. *Graptolites with smooth borders.**

G. scalaris. Unbranched. Stipe alternately spotted, or transversely marked on each side, but with smooth margin. Gradually tapering, and terminating in a slight expansion. Fig. 12. Hall. Utica slate and Hudson River group.

This form differs very materially from the *G. scalaris*, described by Geinitz, in Bronn's Jarbuch for 1840 and 1842. It has rather the aspect of a *G. bicornis* flattened in a plane more or less perpendicular to the direction of the teeth.

G. lævis, Hall. Unbranched. Stipe narrow, flexuous, and slightly tapering. Utica slate (A doubtful form).

For more complete descriptions, &c., of the above species, the reader is referred to the standard work on the Palæontology of New York, by Professor James Hall. Our knowledge of the graptolites generally, is likely to receive considerable additions from some of the projected publications of the Geological Survey.

E. J. C.

* Probably a deceptive appearance, produced by flattening in a particular direction.

ETHNOLOGY AND ARCHÆOLOGY.

PERUVIAN GOLDEN SHROUD.

In a recent communication to the *National Intelligencer*, a correspondent, Mr. Thomas Ewbank, gives some important information in regard to the discoveries made in Peruvian tombs and tumuli derived from W. W. Evans, Esq., a gentleman of strong antiquarian predilections, and now engineer of the Arica and Tacna Railroad, in Peru. Mr. Evans states, that in making excavations for the railroad at Arica, hundreds of graves are demolished in all directions, in which are numerous Indian relics. The excavations are seventy feet deep, and as the soil is loose sand, as the work proceeds, every thing from the top comes sliding down—dead Indians, pots, kettles, arrow-heads, &c. Among other interesting mortuary relics, an Indian was started out of his resting place, rolled up in a shroud of gold. Before Mr. Evans had knowledge of the incident, the workmen had cut up this magnificent winding-sheet and divided it among themselves. With some difficulty Mr. Evans obtained a fragment and dispatched it to Mr. Ewbank. Mr. Evans notices a remarkable fact, that in hundreds of Indians' skulls which he has examined, not one has contained a decayed tooth. Mr. Ewbank thinks the weight of the entire shroud must have been eight or nine pounds, and, had it been preserved, it would have been the finest specimen of sheet gold that we have heard of since the times of the Spanish conquest. In some remarks upon the preservation of souvenirs of the departed, Mr. Ewbank observes: it is the form of features, and not the body, of the dead, that should be preserved. The mummies of Egypt are quarried for fuel, and, whether their wives, their priests, or their slaves, they are split open, and chopped up with the same indifference as so many pine logs. The gums and balsams used in embalming them have made them a good substitute for bituminous coal; and thus the very means employed to preserve them have become the active agents of their dissipation. So it is when the materials of coffins have a high market value, they are then seized as concealed treasure, and their contents cast out as rubbish. Like heroes in the Eastern hemisphere, the descendants of Manco Capec were sometimes, if not always, entombed in such, and with considerable treasure besides, in vessels of gold and silver; hence we learn how the Spanish conquerors sought for, often found, and as often plundered rich Indian sepulchres.

GREEK SLAVE OF THE FIFTEENTH CENTURY.

At a recent meeting of the Society of Antiquaries of Scotland, Mr. Joseph Robertson communicated a notice of a Letter of Safe Conduct and Recommendation granted by James II., King of Scots, to Nicholas Georgiades, a Greek of Arcosson, travelling through Scotland to collect the alms of the Faithful for the ransom of his brother, taken prisoner by the Turks at the capture of Constantinople in 1453.

This document afforded a casual illustration of the feelings which the fall of the capital of the Roman Empire in the East excited even in the farthest frontiers of Western Europe. Six years after that memorable event, a Greek who had lost his all in the siege, and left a brother captive in the hands of the Mahometan conquerors, made his way, maimed of a limb, to the Scottish shore. He bore a letter from the Cardinal of Jerusalem, and on the faith of this, and moved by the wanderer's story as heard from his own lips, the Scottish King, James II., issued a letter under the great seal, taking the goods, person, and servants of the exile under his

especial protection, and recommending the lieges and subjects of Scotland to give their help and favour to the Greek in the pious object of his mission: the gathering, from the charity of Christians, of a sum sufficient to ransom his brother from the power of "those enemies of the Cross of Christ," as they were termed, "the execrable Turks." It appeared that Nicholas Georgiades was not the only Greek of the Byzantine Empire wafted to the distant coast of Scotland. In 1459-60, King James II., ordered a sum of fifteen pounds to be divided between "two Knights of Greece"—warriors, doubtless, whom the triumphs of the Crescent had left without a home or a country. Mr. Robertson, in illustration of the intercourse between Scotland and the East about the end of the fifteenth century, adduced the case of a younger son of Hume of Fast Castle, whom the love of adventure or the spirit of devotion had conducted to the banks of the Nile, where he rose to distinction in the service of the Sultan of the Mamelukes reigning at Cairo. Here tidings reached him that, one after another, eight of his kinsmen had died, leaving him the nearest heir of the gloomy fortress and wild domain which are supposed to have suggested to Scott his picture of Wolf's Crag, the last retreat of the Master of Ravenswood. In order to defray the ransom of his son, the laird of Fast Castle shipped from Leith forty-seven sacks of the wool of the Lammermoors—each sack containing about 640 pounds weight—and the adventurer returned to Scotland in 1509, in the train of that young Archbishop of St. Andrews (the pupil of Erasmus) along with whom he was fated so soon to fall at Flodden. Mr. Robertson added that if we knew more of the individual life of our forefathers, we should perhaps discover that such foreign travels as those of Cuthbert Hume were less unfrequent than might be supposed. The same year, for instance, which saw his return from Egypt, beheld a bailie of the Scottish burgh of Peebles departing on a pilgrimage to Jerusalem.

INDIANS OF GUATEMALA.

Referring to a previous announcement in the *Literary Gazette*, a writer in that journal remarks: "At a recent sitting of the Imperial Academy of Sciences at Vienna, Dr. Scherzer read a paper on a Spanish manuscript discovered in 1854 at Guatemala, containing a complete history of the first Indian population of that part of the continent of America, and an account of their religion, laws and manners. The author of the manuscript is, it appears, a Dominican Monk, named Francisco Ximenez, who was Missionary to the Indians about a hundred and thirty years ago; but as he is known to have written on the Indians in the native Guichey language, it is probably only a translation. It is, notwithstanding, the most valuable account of that interesting race which exists, all previous records having been lost or destroyed. It was for many years feared that all the writings of Ximenes, which were very voluminous, had been lost also; indeed, it was believed that the religious order to which he belonged had caused them to be burned, because he did not hesitate to blame in them the cruel means which the Dominicans employed to convert the Indians; but the manuscript in question was preserved in some convent, and from it was transferred to the University of Guatemala, where it remained until brought to light some eighteen months ago. In the account of the Indian religions it mentions two curious facts,—the first, that the Indian notion of the creation was: that God created eight couples at the same time; the second, that the first of their race in America came from the East, beyond the seas "de la otra parte de la mar del Oriente."

D. W.

CHEMISTRY.

Amorphous Phosphorus, prepared by keeping common phosphorus for some time at a temperature between 446°—482° F. in an inert atmosphere, whereby it becomes incapable of spontaneous inflammation, has lately been used largely in the arts; as thus obtained, it is always mixed with some unaltered phosphorus, from which it is with difficulty purified by repeated washings with sulphuret of carbon, the process is attended with danger. Nickles puts a little of the sulphuret into the retort, in which the conversion has been effected; heats gently to separate the cake, adds a solution of chloride of calcium, of 38°—40° Beaumé, and shakes the mixture. The sulphuret of carbon floats on the surface, containing nearly all the unchanged phosphorus, a second portion will remove every trace, and leave the amorphous substance quite pure.

Chlorine.—C. T. Dunlop employs the residuum of the manufacture of chlorine in preparing an oxide of manganese, which can be again employed for the same purpose, being equal to about 80 per cent. of pure peroxide. The chloride is converted into carbonate by carbonate of ammonia, or by lime and the subsequent treatment of the hydrated oxide with carbonic acid, or by the joint action of carbonic acid and carbonate of lime. The carbonate is heated in contact with the air until oxidized.

Oxide of Cobalt.—By calcining the oxalate, the chloride, or the peroxide, with sal ammoniac, in the two latter cases in a current of oxygen or atmospheric air, and boiling the mass with hydrochloric acid, Schwarzenberg obtained the protoperoxide in the form of octohedral crystals, insoluble in most acids, and not magnetic.

By fusing an oxide of cobalt with hydrate of potassa, for a length of time, he obtained a black, micaceous, soft, scaly substance, which is not acted on by cold dilute nitric acid. On the supposition that cobaltic acid is Co^3O^5 the new salt would be $KO, 3\,Co^3O^5 + 3HO$.

Antimony.—Schneider has determined the equivalent of this metal, by reducing its native sulphide in a current of hydrogen at a low temperature; he finds a number much lower than that of Berzelius, viz. 1503 instead of 1613. [Is it not possible that a small quantity of antimoniuretted hydrogen may have been formed? Berzelius' numbers have not been generally found very incorrect.—H. C.]

Tungsten.—A. Riche prepares the metal by acting on tungstic acid heated with hydrogen for several hours in a porcelain tube. It appears as small hard crystalline grains, infusible in the heat of a furnace, but fusible by 200 Bunsen's elements. It is not oxidized in the air unless at a very high temperature; it combines with chlorine at 572° F. Nitric acid slowly converts it into tungstic acid. At a red heat it rapidly decomposes water. Iodide of tungstmethyle can be obtained in the usual way, and from this the oxide, which forms uncrystallizable salts. The equivalent of tungsten is 87.

The terchloride is obtained by the action of chlorine on the metal, and the bichloride in small quantities by the action of hydrogen on the terchloride. By heating one part of tungstic acid with three parts of charcoal in a current of chlorine, the so called chloride is obtained, which the author finds to be WCl^2O, with 2HO it gives $WO^3 + 2HCl$. The bisulphide was also obtained.

Titanium.—Mr. Duppa has obtained the bromide by passing bromine over a heated mixture of titanic acid and charcoal, and purifying by distillation over mer-

cury. It forms a magnificently crystalline amber-yellow mass. SG=2.6. Fuses at 39°, boils at 230° The chloride boils at 135°. The difference = $3\times31\frac{1}{3}$ which is exactly the same difference as between the bromide and chloride of silicium. According to Kopp, the boiling points of the bromides differ from those of the chlorides by 32° for every equivalent of bromine replacing chlorine. According to this the formula of Titanic acid would be TiO^3, and the equivalent would require alteration. Further experiments are required to test this hypothesis.

Mercury.—R. Weber has examined the behaviour of sulphide of mercury to the compounds of the alkalic metals, and finds that it is capable of forming a crystalline sulpho-salt with the protosulphides of potassium or sodium, which compound however can only exist in presence of free alkali. According to Brunner the potassium salt is $KS+HgS+5HO$.

Silver.—Mr. Hambly has made some valuable experiments on the loss of this metal, resulting during its cupellation. Plattner has also investigated the cause of the loss of silver observed during the roasting of its ores, and he is inclined to believe from some experiments on the subject, that it results from the fact of oxide of silver being formed, which is again reduced in an exceedingly finely divided state, and is thus carried off by the gas of the furnace.

Sulphur in Hops.—It is often of importance to determine whether hops have been treated with sulphurous acid. The old silver test being of little value, Heidenreich evolves hydrogen from zinc and hydrochloric acid, with which the hops have been mixed; the formation of sulphuretted hydrogen, indicated by the brown color produced on passing the gas through a solution of acetate of lead, proves the presence of sulphurous acid. Wagner adopts the same process, but uses a pale solution of nitroprusside of sodium made slightly alkaline. The test is exceedingly delicate, but will not succeed if the hops have been kept some months.

Iodates.—Rammelsberg has carefully examined the crystalline forms of the double salts formed by biniodate of potassa with chloride of potassium and sulphate of potassa. The formulæ are $KCl+KO, 2IO^5$ and $KO.IO+4KO.2SO^3$ the latter being remarkable as containing anhydrous bisulphate.—*Pogg. Ann.* 97, *p.* 92.

Silicium.—Wöhler has described the properties of the graphite modification of silicium, obtained by fusing aluminium with dry silicofluoride of potassium or sodium. The mass is crushed, the aluminium extracted by hydrochloric acid, the silica by hydrofluoric acid, the residue washed. It forms opaque metallic crystalline leaves, very similar to graphite, but with more metallic lustre; it is harder than glass, but softer than topaz. S. G. = 2.490, being less than that of its oxide. Cannot be oxidized by oxygen even when heated to whiteness, infusible, like the amorphous silicium, when heated with carbonate of potassa, it oxidizes and produces combustion. Insoluble in acids, but slowly dissolved by solutions of potassa or soda. Combines readily with chlorine. *Pogg. Ann.* 97, *p.* 484.

Chromates.—Löwe has examined two chromates of bismuth, one obtained by precipitating nitrate of bismuth with chromate of potassa, the other by the action of dilute acids on the salt so formed. The formulæ are $3BiO^3+2CrO^3$ and BiO^3+2CrO^3. J f. Pr. Ch^e 67. 288.

Solubility of Sulphate of Baryta in acids.—Mr. Noad has made some experiments to determine the effect of dilute hydrochloric acid in rendering sulphate of baryta soluble, in reference to Calvert's statements. (Vide ante, No. III., p. 311.)

From these it appears, that in moderately dilute solutions the whole of the sulphuric acid is precipitated by the addition of very little more of the barium salt than is theoretically required, but if the dilution be very great then a loss occurs, which, however, is not found if any excess of the precipitant be employed. As we do not generally precipitate from very dilute solutions, and always employ an excess of the precipitant, no danger need be apprehended from the presence of free hydrochloric acid. Mr. Noad points out, however, that fuming nitric acid often contains sulphuric acid, although it does not give any precipitate with a salt of barium when diluted. By driving off the greater part of the acid, and then diluting, the presence of sulphuric acid may be detected.—*Quar. Jour. of Chem. Soc. No.* 33.

Affinity.—Dr. Gladstone has published a lengthy investigation into the "Circumstances modifying the action of chemical affinity," which does not admit of an abstract.—*Phil. Trans.* 1855, *p.* 179. *Quar. Jour. of Chem. Soc. No.* 33.

Ammoniums.—T. Weltzien has published a very interesting paper on the "Ammonium Molecules of the Metals," and proposes an ingenious theory by which the formulæ of the anomalous compounds of ammonia with the haloid and oxy-salts, the ammonia-cobalt salts of Fremy, and the platinum, palladium and iridium combinations, are reduced to very simple and rational expressions. The paper can scarcely be abstracted without occupying more space in the Journal than the chemical department may justly claim.—*Ann. der Ch. iu Pharm.* 97, 19. H. C.

ENGINEERING AND ARCHITECTURE.

A NEW STEAM HAMMER.

Mr. Naylor, the Norwich superintendent of the locomotive department of the Eastern Counties Railway, has just succeeded in completing an important invention, in the form of a steam hammer, which he believes to be, in many respects, superior to any other that has yet been constructed. Its peculiar qualities consist in its adaptation to all descriptions of work brought under it. It can deal with a small piece of iron with the greatest precision, be it ever so small, or it can efficiently operate upon a piece of iron six or seven inches thick. Such is the command over it that it can be made to strike a light or heavy blow at will, and, if necessary, the light and heavy blows can be given alternately, while it is dealing 200 blows a minute. The rate of working may, moreover, if desired, be reduced to less than 100 blows per minute. Most power hammers obtain their force by their accelerated velocity in their fall. Consequently when working upon a large piece of iron, the greatest force is necessary; but, as the distance of the fall of the hammer is reduced by the thickness of the iron it is operating upon, the full power of the hammer cannot be exercised. Mr. Naylor has, however, a provision for this difficulty, for, by his peculiar and patented arrangements, he can put any amount of steam power upon the hammer in addition to its own gravity, and it matters not, therefore whether the hammer falls through a space of six inches or six feet, so long as its velocity is the same at the instant of its contact with the iron on the anvil. The steam can be applied above as well as under the piston of the hammer, or, by merely turning a small handle, the steam is prevented entering into the top of the cylinder,

leaving the hammer to fall (as others do) by its gravity alone. The fact that this change may be made while the hammer is at work shows the great advantage of Mr. Naylor's arrangement over that of others, and is more striking even to those who do not profess an intimate acquaintance with steam hammers. By having a short blow as effective as a long one, a greater number of blows can be given in the same time, and all practical men know the advantage of striking the iron while it is hot. The hammer weighs about 6 cwt., and its greatest fall is but 18 inches. It is very simple in its construction, yet beautiful in its details. To show its extraordinary power one instance will suffice. We were shown a bar of iron six feet long, three inches wide, and three-quarters of an inch thick, which had been drawn at one heat in eight and a half minutes out of an old block of machinery not more than 12 inches long, thus producing out of the old scrap of iron a bar of new iron of the very best quality. The principle of this hammer has been patented by Mr. Naylor, who considers it equally applicable as a riveting machine for boiler making and iron shipbuilding, as well as for iron making, smith's forging, stamping ore, and, indeed, for all purposes requiring the process of hammering; and to meet every end, it can be worked by elastic gas, compressed air, steam, or vacuum.—*Norfolk News.*

NEW IRON LIGHTHOUSE.

Lieutenant Meade, U. S. Topographical Engineers, has designed a new iron lighthouse for the Florida Reefs. It is now in process of construction by Philadelphia manufacturers. The structure will be 150 feet in height, and 50 feet in diameter at the base. It is built in the form of an octagon, strengthened by eight cast iron columns outside, from which braces and ties extend. The sections, one above the other, are equally well made and secured. The braces are of the most substantial character, but unenclosed.

LITERATURE AND THE FINE ARTS.

SIR WILLIAM HAMILTON.

The announcement of the death of this illustrious philosopher, which took place since our last issue, has been received with the deepest sorrow by all who are capable of appreciating the fruits of his literary labors, and his wonderful intellectual endowments, which fitted him for far greater contributions to his favorite department of mental science, than he has accomplished.

Sir William was the lineal representative of the Hamiltons of Preston, an ancient Scottish family, celebrated in the history of Scotland's covenanting struggle, the head of which was created a baronet in 1673. The title had been dormant for some time, until it was assumed by Sir William in 1816. He is succeeded in the Baronetcy by his eldest son William, born in 1830, now in India.

Sir William was born in Glasgow, on the 8th March, 1788. He had thus completed his sixty-eighth year. After studying at the University of that City, he went to Oxford on the Snell foundation, where he obtained first class honors. He was called to the Scottish bar in 1813. In 1821 he was appointed Professor of Universal History in the University of Edinburgh; and in 1836 he obtained the chair of Logic and Metaphysics, which he occupied to the period of his death.

The following notice is extracted from the *Scotsman:*

Sir William is known to the world chiefly by his contributions to the *Edinburgh Review*, and his edition of the works of Dr. Thomas Reid. The contributions to the *Review* extend from the year 1829 to 1839, and were collected and republished in 1852. His edition of Reid, which was the work of many years of patient and profound thought, first appeared in 1846. These writings are known and prized throughout both Europe and America. Among those who take an interest in philosophical pursuits, it has long been matter of regret that the state of Sir William's health rendered it doubtful whether he should be able to confer systematic completeness on those incomparable philosophical fragments which he from time to time gave to the world, and unfold even more fully his great stores of learning. There is now but one feeling of unmingled sorrow that the great mind which alone could have worthily filled up the sketch it delineated, has passed for ever from amongst us.

By the death of Sir William, the University has lost its greatest ornament, and Scotland one of the most illustrious of her sons. His attainments in general erudition were of the highest order; at once so varied and minute as rarely to be equalled, and in these times certainly unsurpassed. His historical learning, especially, was both ample and profound. In the department of speculative science, with which Sir William's name is peculiarly identified, he stood alone in Britain, if not in Europe—remarkable alike for subtle and profound thought, and for breadth and minuteness of erudition. His writings and academic teaching have inaugurated a new era in the history of Scottish speculation—an era that reflects in a high degree the qualities of mind and habits of thought of its founder. In the hands of Reid, Stewart and Brown, Scottish philosophical thinking was comparatively limited in its range, being chiefly psycological, and its relation to other schools, whether preceding or contemporaneous, were but few and ill-defined. By the influence of the great master, who has so recently departed, Scottish thinking, —while it has lost nothing of its manly independence and its sober but elevated spirit,—has widened its sphere and put itself in contact and alliance both with ancient and modern speculation. The wonderful philosophical erudition of Hamilton peculiarly fitted him for this task. With ancient, mediæval, and modern speculation he was thoroughly familiar. And what is a still rarer circumstance, and one more peculiarly distinctive of a powerful and independent mind, the amplitude of his erudition, instead of impeding or fettering the free exercise of his intellect, only lent it additional stimulus. No thinker, perhaps—at least, no modern thinker —has made greater and better use of the historical results of philosophical inquiry, in the way of moulding and sustaining his own thinking, than Hamilton. But in regard to the historical anticipations of the doctrines of this system, it may be truly said that it is only in the illumination which his own independent reflection has cast upon them that they acquire clearness, distinctness or significance. He walked at large through the domain of the history of speculation; but so obscure in themselves are many of the indications of doctrines which he developed and raised to the highest importance, as at once to impress us with the conviction that what he discovered there was mainly in virtue of the light which he carried with him, and brought to bear on what would otherwise have been faint and undistinguished.

Sir William Hamilton is no more; but he has left behind him a name of which Scotland may well be proud, and which will henceforward be a familiar word in philosophical schools. The doctrines that are peculiarly identified with his name will doubtless form the chief groundwork of philosophical debate in the future

course of Scottish, we may say of European, speculation. His influence will be felt even where his positive teachings may chance to be repudiated. But, apart from his fame as a philosopher, Sir William will long live in the love and veneration of many a pupil and friend—for his heart would indeed be insensible who, having known the man, treasured no fond remembrance of the perfect courtesy and the genuine kindness that were conjoined with an intellect so gifted, and accomplishments so rare.

DANIEL SHARPE, F.R.S.

The "Literary Gazette" announces the sudden death of Daniel Sharpe, Esq., President of the Geological Society, adding another to the list of eminent geologists, including De la Beche, Mantell, Greenough, Forbes, Strickland, and others, whose deaths have recently been recorded. Mr. Sharpe's death was occasioned by his being thrown from his horse while riding in the neighborhood of Norwood, by which he sustained a fracture of the skull.

Mr. Sharpe was not less valued for his labours in philological and ethnological science, than as a successful student of geology. His learned essays on the ancient Lycian inscriptions and coins, appended to the works on Lycia by Sir C. Fellows and Edward Forbes, are enduring monuments of his classical learning and archæological acumen. He was a nephew of the poet Rogers, whom he has so very shortly survived, and was only in his fifty first year, and still in the full vigor of life, when this sad accident abruptly brought all his labors in the cause of science and learning to a premature close.

LITERARY GOSSIP.

The death of James Wilson, Esq., F.R.S.E., distinguished as a naturalist, and greatly loved among Edinburgh circles, is recorded in the Scottish journals. He was a brother of Professor Wilson.

Among the candidates for the Chair of Metaphysics in Edinburgh University, the contest is thought to lie between the Rev. Prof. Fraser, of New College, Edinburgh: the editor of the "North British Review;" and Professor Ferrier, of St. Andrews: the author of "The Institutes of Metaphysics;" both able men, and well fitted for the chair. Besides these, the candidates are: Scott, of Manchester,—formerly of University College, London; Stowell—if we mistake not, the Rev. W. H. Stowell, Professor of Theology, Rotherham College, and author of the "History of the Puritans in England, under the Tudors and Stuarts;" Rev. Dr. McVicar, author of the "Catholic Spirit of True Religion," &c., Ramsay (?), and Thomas Spencer Baynes, the translator of the "Port Royal Logic," and author of "An Essay on the New Analytic of Logical Forms." Morell, Henry Rogers, and others, spoken of as candidates, have not advanced their claims.

Professor Aytoun, the author of "The Lays of the Scottish Cavaliers," &c, is bringing out, one of these days, "Bothwell," a long poem on Mary Queen of Scots.

M. J. Geoffroy Saint Hilaire, the naturalist, Vice President of the Academy of Sciences of Paris, has succeeded to the Presidency, in consequence of the death of M. Binet, the eminent mathematician, and M. Despretz has been elected Vice President.

A Photographic Society has been established in Edinburgh, under the name of the Photographic Society of Scotland. Prince Albert has accepted the post of Patron, and Sir David Brewster undertakes the active duties of President.

Robert Chambers has generously paid over to Mrs. Begg, the surviving sister of the poet Burns, the sum of £200; being the first profits derived from his Life and edition of the Works of the poet.

A SHAKSPEARIAN EPITAPH.

According to a recent correspondent of the Athenæum, there is an epitaph in Tongue Church, Shropshire, ascribed in positive terms to Shakspeare, by William Dugdale, in his Visitation Book. It is on Sir Thomas Stanley, who died about 1600:—

"Not monumental stone preserves our fame,
Nor sky-aspiring pyramids our name.
The memory of him for whom this stands
Shall outlive marble and defacer's hands.
When all to time's consumption shall be given,
Stanley, for whom this stands, shall stand in heaven."

REYNOLDS' SKETCH BOOKS.

Among the various art-treasures accruing to this continent, the Athenæum thus comments on one acquisition in terms that seem to indicate our neighbours in the States have borne off from the dispersion of the Rogers' collection, only "an empty oyster shell!" Its interest, however, is considerable when regarded biographically, whatever be its actual artistic value, and on this account we may refer to it now that it is to be at so accessible a distance as New York.

"Sir Joshua Reynolds used to regret he had not enjoyed the advantages of an academical education in his youth, and always felt that he was unable to draw. The difficulties he laboured under are very apparent in three curious little books recently sold at the Rogers' sale. Two of them were the sketch-books Reynolds used in Italy, and contain notes and sketches of some of the most celebrated pictures and works of art, together with records of dates, places, travelling expenses, and frequent memoranda of colour. They were purchased by Rogers at the sale of the painter's effects, and are now on their way to America, where they can only be valued as having been the actual property of our great painter. Many of the pages, containing merely lead-pencil outlines, display such weak and uncertain drawing as a child would produce, rather than the notes of an experienced artist. Where broad shadow occurs the power of Reynolds may be seen. He worked in masses, not lines, and it is curious, where he was confined to the latter, to observe how he proceeded, adding one line upon the other until he arrived at something like his intention. He floundered, and was anything but academic. These peculiarities, however, were a part of the man, and never thoroughly overcome. In studying the individual artist they form an inseparable part of his character, and afford an insight into his mind. By these books we observe what pictures, scenes, and objects he thought most worthy of treasuring in his memory, and therefore it is to be regretted that they have passed so far from us into private hands where they become mere curiosities. He frequently designed and completed his composition on one and the same canvas, so that the masterly brush strokes at last concealed the wavering pencilings of the beginning. Such weaknesses are not discreditable to Reynolds; and it would be a pity for those who are jealous for his fame to anxiously endeavor to conceal them, since we know that by labour and perseverance these difficulties were at last overcome. He rarely quitted a subject till nothing more was to be desired."

Compared with his pictures, adds the writer in the Athenæum, these books are but a sorry introduction of Sir Joshua to Brother Jonathan. Where his pictures are, his sketch-books ought to have been preserved.

CANADIAN INSTITUTE.

SESSION 1855-56.

SEVENTH ORDINARY MEETING—*9th February*, 1856.

E. A. MEREDITH, Esq., LL. B., Vice President, in the Chair.

The following Gentlemen were elected Members:

R. M. BOUCHER, Esq., Colborne.
EDWARD GOLDSMITH, Esq., Toronto.
WALTER ARNOLD, Esq., Toronto,
W. R. WRIGHT, Esq., Toronto.

The following Papers were then read:

1. By Rev. PROFESSOR YOUNG, M.A.:
   "Brief Notes on Certain Statements of Sir William Hamilton, regarding the Validity of our Primary Beliefs."
2. By PROFESSOR WILSON, LL.D.:
   "Remarks on a Singular Conformation of the Land produced by the Confluence of the St. Louis and Nemadji Rivers into Lake Superior."
3. By PROFESSOR CHAPMAN, Curator:
   "A Report on the Minerals lately received by the Canadian Institute from the Toronto Athenæum."

EIGHTH ORDINARY MEETING—*16th February*, 1856.

G. W. ALLAN, Esq., President, in the Chair.

The following Gentlemen were elected Members:

FRANCIS H. LYNCH, Esq., Toronto.
ROBERT A. HARRISON, Esq., Toronto.
GRANT POWELL, Esq., Toronto.

The following Papers were then read:

1. By JAMES BROWNE. Esq.:
   "On the Manners and Customs of the Aborigines of Australia. Part Second.
2. By THOMAS REYNOLDS, M. D.:
   "On a Collection of Copper Implements and other Ancient Relics found in the neighborhood of Brockville."

The copper implements were exhibited and a selection from them recommended to be engraved, to illustrate the paper in the Canadian Journal. On the motion of Dr. Wilson, it was remitted to Professor Croft to examine and report upon the character of the copper of which the Brockville implements are made, and on the supposed hardening process to which they have been subjected.

3. By G. W. ALLAN, Esq., President:
   "On the Migratory Birds of Canada."

NINTH ORDINARY MEETING—23*d February*, 1856.

G. W. ALLAN, Esq., President, in the Chair.

The following Gentlemen were elected Members:

Rev. W. ORMISTON, B. A., Toronto.
GEORGE CRAWFORD, Esq., M. P. P., Brockville,
FREDERIC KINGSTON, Esq., Barrister at Law, Toronto.

The following Donations were announced, and the thanks of the Institute voted to the Donors:

1. From the Hon. J. M. Brodhead, of Washington:—
"The Army Meteorological Register, for twelve years, 1842 to 1854 inclusive. Compiled from observations made by the Officers of the Medical Department of the United States' Army.
2. From Dr. Carter, of Nelson:—
"Illustrations of Japan, by M. Titsingle, formerly Chief Agent to the Dutch East India Company at Nagasaki.

The following Papers were then read:

1. By Sandford Fleming, Esq., C. E.—
"The Canadian Geological Survey, and its Director, William Edmond Logan, Esq., F.R.S."

After the reading of this communication, it was moved by Mr. Fleming, seconded by Mr. Armour, and resolved:

That the Council be requested to take into consideration the propriety of memorializing the various branches of the Legislature, setting forth the value and importance of the Geological Survey, and the services of Mr. Logan, as its Director, as well as the chief representative of Canada at the London and Paris exhibitions; and that the Legislature, in acknowledgment of the value of the Survey to the material prosperity of the country, and of his services in developing the resources of the Province, be solicited to place the Survey on such a liberal scale as will enable Mr. Logan to carry on to a satisfactory completion, at an early day, this important service; and that a Committee be appointed, with power to take such steps as may seem to them necessary to carry out the object of the proposed memorial.

2. By Professor E. J. Chapman:—
"A Review of the Trilobites; their character and classification."
3. By the Rev. A. C. Geikie:—
"An Inquiry into the Causes of Deterioration in the Population of New England."

TENTH ORDINARY MEETING—1*st March*, 1856.

G. W. ALLAN, Esq., President, in the C[illegible]

The following Gentlemen were elected Members:

WILLIAM G. DICKINSON, M. D., Hamilton,
CHARLES EDWARD ROMAIN, Esq., Toronto.
WILLIAM F. MEUDELL, Esq., Toronto.

Donations were announced from Mr. W. Couper, of a mud-turtle, and a stone curiously perforated by the action of water, both found on "The Island," and the thanks of the Institute were voted to the donor.

The following Papers were read:

1. By P. MacGregor, Esq.—
   "On the Climate of Canada."
2. By Professor Wilson, LL.D.—
   "On the Pictured Rocks of Lake Superior."
3. By Professor Croft, D.C.L.—
   "Analysis of Ancient Copper Relics found in the neighborhood of Brockville, Canada West."

ELEVENTH ORDINARY MEETING—*8th March*, 1856.

G. W. ALLAN, Esq., President, in the Chair.

The following Gentlemen were elected Members:

Rev. A. LORIMER, Librarian, University College, Toronto.
JAMES ALEXANDER, Esq., Toronto.
GEORGE KENT RADFORD, Esq., C.E., Toronto.
EDWARD C. RADFORD, Esq., Toronto.

The following Donations were announced, and the thanks of the Institute voted to the Donors:

1. From T. C. Gregory, Esq., of Windsor:—
   "Annual Report of the Board of Water Commissioners to the Common Council of the City of Detroit."
2. From the author, H. Goadby, M.D., of Detroit.—
   "The Medical Independent and Monthly Review of Medicine and Surgery."
3. From the publishers, Messrs. Gould & Lincoln, of Boston:—
   "Annual of Scientific Discovery, 1856, a Year-book of Facts in Science and Arts."
4. From the editor, E. Billings, Esq., Barrister at Law, Ottawa:—
   "The Canadian Naturalist and Geologist."
5. From the publishers, Messrs. Phillips, Sampson & Co., of Boston:—
   "Prescott's Philip the Second, King of Spain." 2 vols. 8vo."
   "American Almanack, 1856."
6. From the Hon. J. M. Brodhead, of Washington:—
   "The Official Army Register of the United States, for the year 1856."
   "The Navy Register of the United States, for the year 1856."
7. From H. Bovell Hope, Esq.—
   Fifty-five silver coins of Edward II. and III., Edward VI. and Queen Elizabeth.
   "Communications to the Society of Antiquaries of London, on Coins found at different places." Illustrated with engravings.

The following Papers were then read:

1. By Professor Hind, M.A.—
   "On the Blue Clay of Toronto."
2. By Joseph Robinson, Esq.—
   "On 'Fish Jointing' on the permanent way of Railroads."
3. By Professor Croft, D.C.L.—
   "On a New Process for Preventing Explosion in the Camphine Lamp."

TWELFTH ORDINARY MEETING—15*th March*, 1856.

G. W. ALLAN, Esq., President, in the Chair.

The following Gentlemen were elected Members:

Rev. DAVID INGLIS, Hamilton.

S. M. JARVIS, Esq., Toronto.

The following Donations were announced, and the thanks of the Institute voted to the Donor:

By the Hon. J. M. Brodhead, of Washington:—

"United States Official Register for 1855."

"Report on the principal Fisheries of the American Seas, by Lorenzo Sabine."

The following Papers were then read:

1. By the Rev. Professor Young, M.A.—
"A New Proof of the Parallelogram of Forces."
2. By T. C. Keefer, Esq., C.E.—
"On Civil Engineering."

THIRTEENTH ORDINARY MEETING—29*th March*, 1856.

G. W. ALLAN, Esq., President, in the Chair.

The following Gentlemen were elected Members:

HERVEY W. PRICE, Esq., Toronto.
Rev. JOHN JENNINGS, Toronto.
WILLIAM SMART, Esq., Belleville.
Rev. R. J. MACGEORGE, Streetsville.
JOHN O. HATT, Esq., Hamilton.
Rev. EDMUND BALDWIN, M.A., Toronto.
CHARLES GRIFFIN, Esq., Toronto.
A. N. MACLEAN, Esq., Toronto.
F. P. HINCKS, Esq, Toronto.
JOHN C. GEIKIE, Esq., Toronto.
G. M. EVANS, Esq., M.A., Simcoe, C. W.

The following Donations were announced, and the thanks of the Institute voted to the Donors:

1. By James Alexander, Esq.—
"Suggestions for a Simple System of Decimal Notation and Currency."
2. By Mr. W. Couper.—
Six species of exotic Dytescidæ.
Ten species of exotic Lamillicornæ.
A Racoon Skin.

The following Papers were then read:

1. By Colonel Baron de Rottenburg—
"Some Observations on the supposed Self-luminosity of the planet Neptune."
2. By Alfred Brunel, Esq., C. E.—
"Economy of Fuel for Steam Machinery."

The President intimated, by order of the Council, that at the following meeting the Portrait of the First President of the Canadian Institute would be hung up in the Hall of the Institute, and that Sir William Edmond Logan—on whom, since the passing of the resolutions which were then to be carried into effect, Her Ma-

jesty had conferred the distinguished honor of knighthood—had been invited to be present on that occasion, to receive the address prepared in accordance with the resolution of a former meeting.

FOURTEENTH ORDINARY MEETING—*5th April*, 1856.

G. W. ALLAN, Esq., President, in the Chair.

The Hon. J. M. BRODHEAD, Washington, was elected a Life Member.

The following Gentlemen were elected Members:

T. G. HURD, Esq., Toronto.
EDWARD MORTON, Esq., M.R.C.S., Queensville.
A. G. ROBINSON, Esq, C.E., Orillia.
A. W. SCHWIEGER, Esq., C. E., Toronto.
J. ADAMS, Esq., M.D., Toronto.
DANIEL WRIGHT, Esq., Thornhill.
Col. KINGSMILL, Niagara.
T. ARNOLD, Esq., M.D., Toronto.
R. T. PENNEFATHER, Esq., Toronto.
D. A. SAMPSON, Esq, Toronto.

The President, on behalf of the Institute, then presented to Sir William Edmond Logan, an address prepared by the Council in accordance with the resolution of a former meeting. In the fulfilment of this resolution he remarked:

"Gentlemen, before proceeding to the other business of the evening, we have a gratifying duty to discharge to the distinguished and honored guest who is with us to-night. You are all aware that our resolution to adopt some special mode of marking our sense of the valuable services rendered to Canada by the eminent Geologist who first filled the office of President of this Institute, had been fully considered and recorded before the pleasing intelligence reached us that the valuable labors of Sir William Logan, in the cause of science, had been honored by a distinguished mark of the favor of his Sovereign; and that so soon as we had ascertained that his return to Canada, for which he had done so much, might soon be expected, it was unanimously resolved that we, the members of the Canadian Institute, should take the first opportunity, as a body, to tender him our congratulations on his well-merited honors; and further, that we should request him to sit for his portrait, to be hung up here as a lasting memorial of one to whose name we could always point with pride and satisfaction, as the first Canadian who has achieved for himself an European reputation in the world of science. And now, Sir William, with your permission, I will proceed to read the address, on behalf of myself and my brother members, which I am sure is not the language of mere formal compliment, but is sincerely expressive of the feelings of affectionate esteem and respect entertained towards you by every member of this Institute." The President then read the following

ADDRESS

TO SIR WILLIAM EDMOND LOGAN, F.R.S., F.G.S., &c. &c. &c.

CANADIAN PROVINCIAL GEOLOGIST.

We, the President, Council, and Members of the Canadian Institute, beg to offer you our cordial welcome on your return to Canada, after the successful completion of your labors on behalf of the Province at the Parisian Crystal Palace, and to

tender to you our most hearty congratulations on the high, but justly merited, honors with which it has pleased Her Majesty to mark her sense of your distinguished merits as the foremost in the ranks of scientific men in this Province of the Empire.

We rejoice in the fresh evidence which your reception of the distinguished honor of knighthood affords, of our full share, as Canadians, in all the honors and privileges which pertain to the members of the United Empire; while we feel a peculiar gratification, as members of this Institute, in hailing as the recipient of one of the highest distinctions conferred on men of science by the British Sovereign, one on whom the first choice of this Institute fell to fill its presidential chair.

In now adorning our Hall of meeting with your portrait, permit us to assure you that while our estimate of your distinguished rank as a scientific geologist, and your disinterested and indefatigable zeal in all that can develope the resources and promote the true interests of Canada, cannot be affected by any distinctions conferred on you, we fully sympathise in the just pride which you must feel in being made a recipient of the same honors which British Sovereigns have already employed to mark with peculiar distinction the intellectual achievements of a Newton, a Davy, a Brewster, a Lyell and a Murchison. Nor can we withhold the expression of our congratulations on other no less merited honors, and especially on your receipt, by the award of your scientific brethren, of the Wollaston Medal; one of the highest marks of distinction with which they could testify their sense of the rank you have achieved in your labors as a Canadian geologist.

In the same spirit we now seek to confer on you such evidences of our appreciation of your successful labors in the cause of science as it is in our power to bestow; and, humble as is our position in relation to science, we venture to hope that our cordial congratulations will not be the less acceptable that they are addressed to the most distinguished among the scientific men of Canada, by a Canadian Institution.

Sir William Logan replied—' Mr. President, I am very grateful to yourself, to the Council, and to the Members of the Canadian Institute, for the very flattering manner in which you have been pleased to speak of me in your address—for your kind welcome—and for the congratulations which you offer me, on my success in France and in England. Whatever distinctions, however, may be bestowed on us at a distance, it is upon the respect, esteem, and confidence shewn us at home, that our happiness and satisfaction must chiefly depend. I can assure you, with sincerity, that the honor conferred upon me when you elected me the First President of the Institute, was one highly prized, although the circumstances of a distant domicile, and the intent pursuit of the investigations with which I am charged, rendered it extremely difficult for me to be of much use in your proceedings. And I feel it as no slight compliment that you should place a memento of me by the side of my friend, and much more worthy successor, Colonel Lefroy, whose constant exertions in the exact observation of Meteorological phenomena, have tended so greatly to spread the name of Toronto in the scientific world. It is a fortunate circumstance for me that my name should be connected with an act of grace on the part of Her Majesty, which serves to confirm your feeling in regard to the fact that as Canadians we enjoy a full share in the honors and privileges of British subjects. And I am proud to think that it was, perhaps, more because I was a

Canadian, in whom the inhabitants of the Province had reposed some trust, that the honor which has been conferred upon me by Her Majesty was so easily obtained. That I am proud of the honors which have been bestowed upon me by the Emperor of France, in respect to my geological labors, and also by my brother geologists in England, there can be no doubt. But I have striven for these honors because I have considered they would tend to promote the confidence which the inhabitants of the Province have reposed in me, in my endeavors to develope the truth in regard to the mineral resources of the Province; and in this work none could have been more interested in my success than the Members of this Institute. We have on the other side of the hall* an evidence of the interest taken by the Institute in the Geological Survey, and you have, in publishing what appears within that frame, published the one-half of what is included in the enlarged map which I presented to the exhibition at Paris. You have in it the whole of the Geology of Canada, as far as it is at present understood, and I think it will, perhaps, not be disagreeable to you that I should submit a short account of its leading features."

Sir William then proceeded to explain the Geological Map, and illustrated, first, the conformity of the physical structure of the country to its geography; secondly, the difference in conditions between the eastern and western troughs of North America which run through Canada; and thirdly, a circumstance which is considered a very striking one in regard to the physical structure of Canada; the want of all the formations which exist between the Laurentian rocks and the Upper Silurian, viz., the whole of the Lower Silurian rocks on the north side of the granite ridge. He had learned, while in Europe, that this last circumstance was applicable also to Russia. These facts, proving the existence of land round the North Pole, at the time of the deposit of the Lower Silurian, were three great scientific facts which have been brought out by the examination made by himself and his associates in Canada.

The Wollaston Medal, and the Gold Medal of Honor received by Sir William from the Emperor of France, were then produced for the inspection of the Members, along with a work containing the sketch of the Geology of Canada, which he had considered it proper to prepare and present to the Jury of the first class, as explanatory of the Geological Map in the Paris Exhibition.

The following Papers were then read:

1. By Paul Kane, Esq.—
   "On the Habits and Customs of the Walla-Wallas, one of the North American Indian Tribes," from the Journal of the Author.
2. By Professor Chapman:—
   "Brief Notes by Lieutenant Maury, of Washington, on some comparative phenomena of the North and South Atlantic Oceans."
3. By Professor Chapman:—
   Some fossil specimens from the Crimea examined and described.

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* The Geological Map of Upper Canada, published in the Journal, Old Series, Vol. II, p. 1, to illustrate Sir William Logan's paper, "On the Physical Structure of the Western District of Upper Canada," which occupied one side of the Hall was here referred to. On the other was hung the large Parisian Geological Map of the whole Province, and the neighbouring districts, which he employed in illustrating the peculiar physical structure and geological formations both of Upper and Lower Canada, as established by the labours of the Geological Survey.

SIXTEENTH ORDINARY MEETING—19*th April*, 1856.

G. W. ALLAN, Esq., President, in the Chair.

The following Gentleman was elected a Member:

Rev. Professor AMBERY, M. A., Trinity College, Toronto.

The following letter from the Provincial Secretary was read.

Secretary's Office,
Toronto, 15th April, 1856.

Sir—I am commanded by His Excellency the Governor General, to acknowledge the receipt of the Memorial of the Canadian Institute, signed by you, as the President of the Society, praying His Excellency to cause provision to be made for carrying on the Geological Survey of the Province on a more extended scale, so as to insure its completion in every detail, at the earliest possible period.

His Excellency desires me to request you to assure the Canadian Institute that he entirely coincides in the opinion expressed in their Memorial, as to the importance to the Province, both in a scientific and economical point of view, of the Geological Survey, and as to the value of the services of the distinguished Canadian by whom it has been conducted.

I am to add that the prayer of the Memorial will receive His Excellency's full consideration.

I have the honor to be,
Sir, your most obedient servant,
GEORGE E. CARTIER,
Secretary.

G. W. Allan, Esq., President Canadian Institute,
Toronto.

The following Donations were announced, and the thanks of the Institute voted to the Donors:

1. By Robert A. Harrison, B C.L., Toronto—
   Package of Antiquarian Papers.
2. By T. C. Gregory, Esq., Windsor, C. W.—
   Collection of Fossil Elk Horns.
3. By W. C. Chewett, Esq., M. D.—
   A letter was read by Professor Cherriman from Dr. Chewett, intimating a donation of Fifty Pounds worth of Books to the Library of the Institute, to be selected by the Council, from the stock of Messrs. Maclear & Co.
   On the recommendation of the Council, Dr. Chewett was nominated for election as a Life Member.
4. By the Publishers, through A. H. Armour, Esq.—
   "Appleton's Cyclopædia of Biography." 1 vol.
5. By the Hon. J. M. Brodhead, of Washington—
   "Maps and Views to accompany the President's Message and Documents, 1854-5." 1 vol.
   "Dr. Jackson's Report on the Michigan Mineral District, 1847-9, with Geological Maps, &c."
   "Forster & Whitney's Reports on the Copper and Iron Districts of Lake Superior. Parts I. and II., 1850-51, with Geological Maps, &c."

The following Papers were then read:

1. By E. A. Meredith, Esq., LL.B.—
   "On the Influence of the recent Gold Discoveries on Prices."

2. By the Rev. Professor Young, M.A.—
"A Review of Reichenbach's researches on Animal Magnetism."

SIXTEENTH ORDINARY MEETING—*26th April*, 1856.

G. W. ALLAN, Esq., President in the Chair.

W. C. CHEWETT, Esq., M.D., was elected a Life Member.

The following Gentlemen were elected Members:

JOHN J. VICKERS, Esq., Toronto.
CHRISTOPHER DUNKIN, Esq., Advocate, Montreal.
JOSEPH LESSLIE, Esq., Toronto.
JOHN ROAF, Esq., Toronto.
FREDERICK O'BRIEN, Esq., Barrie.
W. S. CONGER, Esq, M.P.P., Peterborough.

The following Donations were announced, and the thanks of the Institute voted to the Donors:

1. From the Regents of the University, ex officio Trustees of the State Library, on behalf of the State of New York:—
"Documents relating to the Colonial History of the State of New York." 1 vol. 4to., being vol. VI. of the work.
"New York Meteorology, from 1825 to 1850." 1 vol. 4to.
"Sixth Annual Report of the Regents of the University of the State of New York."
"Annual Report of the Trustees of the New York State Library."
2. From J. McNaughten, Esq, P.L.S., Ottawa City:—
A Map varnished and mounted of "The Geographical Position of Canada and adjacent countries, &c."
3. By Mr. W. Couper.—
Fourteen species of Lamellicornæ, with duplicates of four—exotic.
One Elater—exotic.
Two species of Buprestidæ—exotic.

The following Papers were then read:

1. By Professor Bovell, M.D.—
"On the Unity of the Human Race."
2. By P. MacGregor, Esq.—
"On the Physiological Character of the Climate of North America."

This being the last ordinary meeting of the session, H. Mortimer, Esq. and J. Stevenson, Esq. were appointed Auditors, in accordance with the laws; and the President, after congratulating the Institute on the conclusion of a highly prosperous session, adjourned the meeting till November.

MONTREAL NATURAL HISTORY SOCIETY.

ORDINARY MONTHLY MEETING—*April*, 1856.

Mr. Dutton submitted the following report:—

The Committee appointed at the last monthly meeting of the Natural History Society, to inquire into the best methods of rearing fish from spawn, with the view to promote that department of Natural History, and render it subservient to the interests of the Province of Canada, beg to report—

That your Committee have not had an opportunity of discussing the subject or maturing any plan in reference to it, in consequence of the absence of Mr. Alfred

Perry, at Toronto, during the greater part of the intervening time; and, therefore, beg further time for that purpose. Respectfully submitted,

Jos. T. Dutton.

Montreal, 31st March, 1856.

The report was received and adopted; and the Committee allowed until next ordinary meeting to draw up their report.

The following donations were received, and the thanks of the Society ordered to be conveyed to the respective donors:—from Dr. Kingdom, R. C. Rifles, three volumes of Reports, embracing the Meteorology of the United States, from 1826 to 1842 inclusive. From W. Woodwork, Esq, of St. Eustache, two curious specimens of Indian corn.

Dr. Barnston read the following report:

Report of the Sub-Committee authorised by the Committee appointed by the Council of the Natural History Society of Montreal, at a special meeting held 19th March, 1856, to examine the Meteorological Observatory of Charles Smallwood, M. D., at St. Martin, Isle Jesus, C.E. and to report thereon.

On Tuesday, March 25th, the Committee, consisting of the Vice-Presidents, Drs. Workman and Hingston, Mr. Rennie, and Dr. Barnston, assembled at the Council-room of the Natural History Society, and left town at half past three in the afternoon, in company with a few other gentlemen interested in the promotion of Meteorological science. After a somewhat perilous journey over bad roads, they arrived safely in the village of St Martin, where they were received by Dr Smallwood, who shewed every attention to his visitors, and exhibited the whole apparatus connected with his Observatory, at the same time explaining the nature and uses of each instrument. From the information derived through his kindness, the Sub-Committee are enabled to furnish the Society with the following details, which are by no means so minute and extended as they could desire.

The Observatory is situated in the village of St. Martin, on the Isle Jesus, about nine miles due west of Montreal, in lat. 45° 32′ N. and long. 73° 36′ W., or 4 h. 54 m. 20 s. in time from Greenwich. It is a small square wooden building, conveniently situated in an open space, a few yards N. W. of his dwelling house. It is placed in the magnetic meridian, and its roof is furnished with a sliding shutter, which, when opened, enables him to obtain observations of stars as they pass the meridian, for which purpose a small transit instrument is used. The apparatus to be seen within the building may be described as follows:

Of the *Barometers* there are—1. A Newman's standard, the brass scale of which extends from the cistern to the top of the tube. The tube itself is 0.6. of an inch in diameter internally, and is so contrived that its oscillations can be taken by photography;—2. A standard by Negretti and Zambe; and—3. Another instrument with a smaller tube. The cistern of the barometer is 118 feet above the level of the sea.

The *Thermometers* consist of Rutherford & Lixes' self-registering—a standard thermometer where the reading coincides with that existing at the Kew Observatory. There is likewise a wet bulb-thermometer (or psychromatic) from which are deduced the temperature of the dew point, the elastic force and weight of aqueous vapour, and the humidity of the atmosphere.

The observatory also possesses an instrument for registering the intensity of the solar rays, and another for terrestrial radiation—the latter being furnished with a parabolic speculum, possessing 100 inch focus.

The *Anemoscope* is self-registering, and shews the direction of the wind; while the *Anemometer* records constantly its velocity in miles. The latter instrument is simple and novel in construction, and furnishes results which coincide with those in use at Toronto, Liverpool, and other places. Attached to it is a self-registering *Rain-guage*, which shews the commencement and the termination of each fall of rain and the amount in tenths of an inch.

The *Snow-guage* presents a surface of two hundred square inches, while there is an *Evaporator*, with a surface of fifty inches.

Among other instruments may be mentioned those:—1. For ascertaining the amount of dew; 2. For measuring the amount of water in a given quantity of snow; and 3. For the measurement of the degree of evaporation from the surface of ice.

The quantity of *Ozone* is registered by the methods adopted by Schombien and Moffat.

Without the building, is the apparatus for the investigation of atmospheric electricity, consisting of a long pole, 70 feet high, furnished with a slide or groove, by means of which is hoisted an apparatus to which is attached a collecting lantern. This is supplied with two lamps which are kept constantly burning in order to secure insulation. The electricity thus collected is conveyed by copper wires to a conductor within the observatory, where it is connected with a variety of electrometres and other contrivances by which is precisely ascertained the *intensity* and *kind*.

Investigations are also made on the formation and varied shapes of snow-crystals, of which copies were exhibited as obtained by the Chromotype process, which is intended to be likewise applied to the self-registration of the Barometer and Thermometer.

The fixed hours of observation daily are, 6 and 7, A. M., and 2, 9 and 10, P. M. Extra hours are often requisite, and indeed hourly and minute observations are sometimes necessary.

It may be also mentioned that Dr. Smallwood invariably records observations upon storms, the aurora borealis, meteors, and other phenomena, while notice is taken regularly of the periodic appearance of animals, birds, &c., as well as the time of the leafing and flowering of plants.

Such then is but a short description of the apparatus by means of which Dr. Smallwood has for many years sedulously carried out his valuable Meteorological observations. The whole has been constructed at his own expense; and while many of the instruments bespeak their own cost, there are not a few contrived by himself, which exhibit a vast amount of ingenuity, combined with simplicity and economy. Not to speak of the outlay necessary to complete such a series of apparatus for standard observations, the greatest credit is due to Dr. Smallwood for the indefatigable manner in which he has laboured for years in the cause of Meteorological Science—unassisted by Government patronage, and unrecognised, even to the present day, by any Scientific Society or Institution. His observations extend so far back as the year 1841. Year by year he has varied and extended his investigations by means of gradual additions and new contrivances, until at the present time, in spite of all difficulties and the shameful short-coming, on the part of those Authorities, Societies and Institutions, which should have extended to him the right hand of support and recognition, it may be asserted, we believe, without contradiction, that he possesses the simplest and most ingenious

series of apparatus for Meteorological Observations in the Province; nor can it be denied that, although the records of his investigations are still confined to manuscript, he has already, by example as well as by occasional publications of part of his labours, done much to advance the cause of Meteorology in Canada.

The Sub-Committee notice with pleasure the munificence of the Provincial Government in providing the Upper Province with the means for the establishment of several efficient stations for Meteorological purposes, and why should the valuable records of unquestionably the first Meteorologist in Lower Canada, extending fifteen years back, be dormant and unseen? It is for this Society—coming, as it does, within her legitimate province—to answer this question; and if the Provincial Government is likely to omit an acknowledgment, which it owes to a private individual, or to neglect an equally important duty to Lower Canada; in other and plainer words, to sacrifice it to the interests of its more favored sister Province, the Sub-Committee have no reserve in urging upon this Society, most respectfully but most strenuously, the *necessity* of taking the subject into immediate consideration, and of adopting such measures as will most speedily bring to light the valuable but still hidden records of Dr. Smallwood's extended experience, and recommending at the same time the provision of such ample means as will enable him to carry out more effectually those observations which will, no doubt, ultimately and under more favorable circumstances, lead to important results—creditable alike to Science and its votary, and beneficial to the general welfare of the public.

W. H. Hingston, M. D.,
James Barnston, M. D.

Montreal, March 31st, 1856.

On motion of Rev. A. D. Campbell, seconded by Ass't Com. Gen. Ibbetson, it was resolved that the Report of the Sub-Committee of the Council appointed to report on the recent visit of a deputation to Dr. Smallwood's Meteorological Observatory, be adopted and be referred to the Council, with full power to found a petition thereon, to the Houses of Legislature, now in session, for a supplementary grant in aid of Dr. Smallwood's efforts; for the establishment of a Provincial Observarory in Montreal or its neighbourhood; and for the general advancement of Meteorological Science in Lower Canada.

The meeting then proceeded to ballot for members, when the following were elected:—

As Corresponding Members:—Hon. G. E. Cartier, Hon. F. Lemieux, and A. Brunel, Esq., of Toronto, and Rev. W. Brethour, M. A, of Ormstown.

As Ordinary Members:—Rev. Professor Thomson, M. A., of Lennoxville; Rev Canon Gilson, M. A.; Deputy Com. Gen. Clarke, and John W. Haldimand, Esq., of Montreal.

L. A. H. Latour, Esq., intimated that he was about to publish, in three volumes, a Manual of Dates, in form of Chronology, or encyclopedical repertory of the most important historical dates. This work he proposed to dedicate to the Members of the Natural History Society.

A. N. Rennie,
Secretary.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—APRIL, 1856.

Latitude—43 deg. 39.4 min. *North*. *Longitude*—79 deg. 21 min. *West*. *Elevation above Lake Ontario*, 108 *feet*.

Day.	Barom. at Temp. of 32°.				Temp of the Air.				Mean Temp. + or − of the Average.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Mean Direction.	Velocity of Wind.				Rain in Inches.	Snow in Inches.
	6 A	2 P. M.	10 P M.	MEAN	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10PM	ME'N		
					°	°	°	°													°						
1	30.061	29.965	29.871	29.9607	15.1	35.2	28.7	27.58	— 3.68	.072	.148	.132	.121	.80	.72	.83	.80	N b E	S S E	E N E	E 14 S	0.8	4.8	0.6	2.51	...	...
2	29.630	.423	.294	.4313	30.9	37.5	37.3	34.92	— 1.72	.143	.184	.201	.172	.82	.89	.91	.85	E	E b S	S b W	E 14 S	6.2	6.2	2.4	4.95	0.550	...
3	.205	.236	.298	.2593	37.3	40.8	35.9	37.95	+ 0.93	.194	.193	.195	.196	.87	.76	.92	.86	S b E	S W b S	S W	S 42 W	0.2	11.6	5.8	6.35	.175	...
4	.348	.461	.585	.1797	34.8	36.6	32.8	34.45	— 2.88	.178	.169	.150	.163	.89	.78	.80	.82	W N W	N N W	W b N	N 43 W	5.2	6.6	5.5	7.37	...	0.1
5	.605	.632	.660	.6355	31.2	42.0	36.0	36.72	— 1.00	.155	.172	.165	.163	.89	.65	.79	.76	N W b N	N W b W	N W b W	N 39 W	11.2	10.2	1.8	6 21	...	...
6	.650	.620	—	—	31.9	44.7	—	—	—	.159	.191	—	—	.89	.66	—	—	Calm.	S	S S W	S 37 W	0.0	2 6	0.2	2.42	...	...
7	.658	.710	.744	.7087	35.9	49.7	36.6	40.92	+ 2.50	.201	.163	.160	.171	.96	.46	.74	.69	N W	S b W	Calm.	W 45 S	3.0	4.2	0 0	1.19	...	...
8	.837	.864	.808	.8350	39.9	53 7	39.0	44.72	+ 3.00	.152	.200	.161	.169	.88	.56	.68	.66	Calm.	S	E S E	E 30 S	0.0	3.8	0.4	2.37	...	...
9	.737	.515	.748	.6695	37.0	57.0	39.1	45.07	+ 6 03	.167	.258	.183	.206	.77	.57	.77	.69	Calm.	S W	N W b N	W 36 N	0.0	16.0	14.1	11.89	Inap	...
10	.989	.965	.900	.9440	31.6	42.1	32.8	35.75	— 3.67	.111	.146	.133	.124	.63	.55	.71	.62	N W	S b W	Calm.	N 22 N	12.2	7.4	0.0	4.42	...	...
11	.796	.631	.435	.6107	30.9	48.3	39.9	39.58	— 0.15	.137	.218	.165	.172	.79	.66	.67	.71	Calm.	S S E	E b S	E 32 S	0.0	1.7	3.0	2.17	.230	...
12	.174	.168	.600	.3250	40.2	39.9	30.9	36.67	— 3.47	.235	.202	.143	.183	.95	.83	.82	.83	Calm.	N	N	N 6 W	0.0	13.4	15.0	13.21	.545	...
13	.909	.924	—	—	23.9	34.8	—	—	—	.060	.090	—	—	.46	.45	—	—	N b E	S b W	W N W	S 45 W	4.5	9 8	1.2	5.33	...	...
14	.731	.580	.525	.6023	33.2	39.8	36.3	36.58	— 4.15	.167	.158	.155	.161	.88	.65	.73	.75	S S W	S E b S	E b S	S 2 W	6.0	2.4	0.5	1.44	Inap	Inp
15	.545	.478	.487	.5008	37.7	38.9	41.6	39.95	— 1.10	.159	.224	.216	.205	.71	.95	.83	.83	Calm.	E	E	E 1 N	0.0	21.0	19.2	15.44	.705	...
16	.484	.475	.535	.4965	39.2	51.2	41.8	44.15	+ 2.67	.211	.288	.238	.249	.89	.78	.91	.87	S E b E	E N E	Calm.	E 6 N	12.5	9.8	0.0	6.01	...	...
17	.524	.421	.369	.4265	42.7	50.6	40.9	46.27	+ 4.52	.239	.314	.235	.257	.84	.86	.93	.82	S W b S	S b W	S b W	W 9 S	0.5	1.9	0 4	1.82	.015	...
18	.307	.354	.433	.3907	40.2	54.1	45.5	46.03	+ 3.97	.216	.203	.249	.244	.88	.64	.83	.80	Calm.	S W b S	W b W	W 25 S	0.0	4.0	0.9	3.84	.115	...
19	.612	.638	.662	.6448	41.8	16.9	44.7	44.20	+ 1.85	.240	.189	.097	.182	.92	.59	.32	.64	N N W	S E b E	N	N 23 E	0.6	6.0	23.0	8.91	...	...
20	.838	.761	—	—	32.7	44.9	—	—	—	.138	.173	—	—	.74	.58	—	—	N b E	N	N	N 7 E	12.8	21.5	9.5	14.16	...	...
21	.607	.533	.326	.4065	38.4	43.1	47 4	43.35	+ 0.25	.196	.191	.290	.227	.85	.69	.99	.81	N E	N E b N	N E b N	N 18 E	9.8	1.1	15.8	8.31	.315	Inp
22	.244	.195	.206	.2373	36.3	40.4	35.9	37.22	— 6.15	.208	.219	.175	.202	.98	.88	.82	.91	N b W	S b W	Calm.	E 44 S	3.5	1.0	0.0	2.94	.070	...
23	.372	.411	.452	.4165	32.7	51.7	40 2	41.25	— 2.45	.164	.246	.204	.209	.89	.65	.83	.81	Calm.	S E b E	Calm.	E 6 S	0.0	1.0	0.0	2.69	...	...
24	.490	.484	.804	.5355	40.4	46.7	42.9	43.55	— 0.45	.216	.262	.244	.233	.87	.83	.90	.83	Calm.	S E b E	N W b W	N 2 W	0.3	0.2	1.0	3.48	.035	...
25	.742	.788	.856	.7983	46.0	61.6	44.2	52.02	+ 7.62	.218	.290	.238	.251	.71	.53	.84	.66	N b W	S S E	E S E	E 9 N	4.5	4.0	0.7	2.97	...	...
26	.848	.765	.678	.7580	45.2	60.0	50 6	52.58	+ 7.88	.218	.297	.301	.269	.73	.59	.83	.69	N b E	E S E	N	E 4 S	5.0	7.7	2.0	4.67	...	...
27	.674	.548	—	—	48.8	63.5	—	—	—	.273	.346	—	—	.80	.61	—	—	E	E	Calm.	S 20 E	4.9	8.2	0.0	2.28	.025	...
28	.493	.101	.449	.4610	53.1	65.0	61.0	59.83	+ 14 43	.329	.253	.220	.271	.83	.42	.42	.56	Calm.	S S W	W N W	W 23 S	0.0	19.5	17.0	10.04	...	...
29	.580	.586	.701	.6283	47.7	61.7	45.8	53.10	+ 7.37	.233	.322	.215	.249	.72	.60	.71	.64	Calm.	S S W	N N W	N 28 W	0.0	8.6	5.0	7.76	...	...
30	.789	.852	.889	.8408	46.3	50.5	45.9	47.75	+ 1.70	.217	.219	.208	.212	.70	.61	.68	.65	N b E	E b S	E b N	E 7 N	8.8	11.5	10.6	14.24	...	...
M	29.5926	29.5589	29.5867	29.5799	37.57	47.81	40.53	42.27	+ 1.28	.191	.223	.195	.203	.83	.68	.77	.75	N 25 E	S 33 E	N 24 E	N 29 E	3.74	7.59	5.19	6.05	2.780	0.1

Highest Barometer ..... 30.099 at 8 a. m., on 1st } Monthly range=
Lowest Barometer ..... 29.081 at 8 a. m., on 12th } 1.018 inches.

Highest registered temperature..... 72°2 at p. m., on 28th } Monthly range=
Lowest registered temperature ..... 14°2 at a. m., on 1st } 58°0

Mean maximum Thermometer..... 50°47 }
Mean minimum Thermometer ..... 33°39 } Mean daily range = 17°08

Greatest daily range ..... 29°4 from p. m. of 9th to a. m. of 10th.
Least daily range..... ..... 5°3 from p. m. of 2nd to a. m. of 3rd.

Warmest day..... 28th ... Mean temperature..... 59°83 } Difference = 32°28.
Coldest day..... 1st ... Mean temperature ..... 27°55 }

Greatest intensity of Solar Radiation ... 85°4 at p. m. on 29th } Monthly range=
Lowest point of Terrestrial Radiation ... 6°5 at a. m. of 13th } 78°9

Aurora observed on 4 nights, viz.: 8th, 22nd, 28th, and 29th; possible to see aurora on 18 nights; impossible to see aurora on 12 nights

Snowing on 3 days, depth 0.1 inch—snowing 2.5 hours. Raining on 13 days, depth 2.780 inches—raining 62.6 hours.

Mean of cloudiness =0.60; most cloudy hour observed, 8 a. m, mean =0.71; least cloudy hour observed, midnight, mean, =0.47.

Sum of the Atmospheric Current, in miles, resolved into the four Cardinal directions.

North.	West.	South.	East.
188·42	1012.32	851.39	1576.10

Mean direction of the wind, N 29° E.

Mean velocity of the wind ..... 6.05 miles per hour.

Maximum velocity ..... 26·4 miles per hour, from 6 to 7 p. m., on 9th.

Most windy day .....15th...Mean velocity 15.41 miles per hour.

Least windy day ..... 7th...Mean velocity 1·19 ditto.

Most windy hour ...11 a. m. to Noon . Mean velocity 7·99 ditto.

Least windy hour ..... 6 to 7 a. m....Mean velocity 4.35 ditto.

Mean diurnal variation = 3·64 miles.

2nd—First rain since 15th December, 1855.

7th—Butterflies first observed.

8th—Large and perfect Halo round Sun at 5h. 39m., p. m.

10th—Halo round moon (diameter, 46°) at 11h. 45m., p. m.

12th—First Thunder and Lightning of the Season.

13th—Halo round the Moon at 10, p. m., (very perfect).

15th—Thunderstorm, vivid lightning and heavy rain, from 10 p. m.

16th—Frogs first heard.

19th—Halo round Moon, at midnight.

19th—Ice disappeared from the Bay.

23rd—Lunar Rainbow at 2 a. m.. perfectly defined.

30th—Patches of drifted snow still remaining in the Ravine near the Observatory.

COMPARATIVE TABLE FOR APRIL.

Year	Temperature. Mean	Diff. from Aver.	Max. obs'd.	Min. obs'd.	Range.	Rain. Days.	Inch's.	Snow. Days.	Inch's.	Wind. Mean Direc'n.	Mean Force or Velocity.
	c	c	c	c	c						
1840	42.4	+1.0	65.9	25.3	40.6	14	3.420	2	...	...	...
1841	39.2	−2.2	62.9	22.1	40.8	3	1.370	3	...	...	0.51 lbs.
1842	43.1	+1.7	89.5	21.6	67.9	8	3.740	2	...	...	0.57 "
1843	40.9	−0.5	70.0	15.1	54.9	7	3.185	3	0 1	...	0.46 "
1844	47.5	+6.1	74.5	17.2	57.3	10	1.515	1	Inapp	...	0.24 "
1845	42.1	+0.7	66.0	14.8	51.2	11	3.290	4	1.5	...	1.00 "
1846	44.0	+2.6	79.4	24.4	55.0	10	1.300	2	1.3	...	0.55 "
1847	39.2	−2.2	65.6	8.1	57.2	8	2.870	2	4.0	...	0.59 "
1848	41.3	−0.1	65.4	26.5	38.9	5	1.455	1	0.5	W 24 N	4.89 miles.
1849	39.0	−2.4	70.9	23.2	47.7	10	2.655	2	1.7	N 42° W	7.50 "
1850	37.9	−3.5	63.2	18.2	45.0	7	4.720	2	1.1	N 39° W	7.64 "
1851	41.3	−0.1	59.2	25.8	33.4	11	2.295	3	1.2	N 17° E	8.07 "
1852	38.2	−3.2	53.8	19.8	34.0	6	1.990	4	9.4	N 23° E	6.68 "
1853	41.9	+0.5	65.7	27.0	38.7	10	2.625	1	1.0	N 12° W	5.20 "
1854	41.0	−0.4	65.1	22.3	42.8	12	2.685	4	2.7	E 37° N	6.82 "
1855	42.4	+1.0	63.8	12.2	51.6	8	2.030	3	1.6	N 36° W	7.57 "
1856	42.3	+0.9	69.8	15.1	54.7	13	2.780	3	0.1	N 29° E	6.05 "
Mean	41.39	...	67.69	19.94	47.75	9.0	2.584	2.5	1.9	...	6.71 miles.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—APRIL, 1856.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D.

Latitude—45 deg. 32 min. North. Longitude—73 deg, 36 min. West. Height above the Level of the Sea—118 feet.

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Mean direction of Wind.	Velocity in miles per hour.			Snow in Inches.	Rain in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.			6 A.M.	2 P.M.	10 P.M.
1	30.241	30.191	30.14	10.7	42.3	27.5	.080	.208	.119	84	73	68	s w b w	s w b w	s w b w	w 3 s	2.97	3.31	4.86	...	...	Clear.	Cir. Str 2.	Clear, Zod. Light
2	29.969	29.714	29.610	16·0	50.2	36.1	.092	.304	.176	83	81	76	s s w	s s E	s s E	E 1 s	1.55	0 89	0.90	...	..	Do.	Cum. Str 2.	Cum. Str 9.
3	.546	4.51	.52	35.0	49.5	38.0	.210	.336	.231	86	90	95	s s E	s s E	s w	s 36 E	3.71	0.91	0.10	...	0 100	Cum. Str. 6.	Do. 9.	Do. 10, rain.
4	.532	.584	.64	34.4	45.9	35.1	.201	.262	.203	96	80	91	s w b y w	s w b w	w	w 33 s	1.33	1.12	0.15	...	0 1 5	Rain.	Str. 10.	Str. 10, sli't rain
5	.649	.685	.74	35.2	45.0	38.4	.203	.255	.229	91	81	91	w b y s	w s w	w s w	w 22 s	0.62	0.87	4 51	...	1np	Str. 10.	Do. 10.	Hazy.
6	.787	.757	.78	34.4	54.4	36.7	.186	.304	.210	87	70	91	w	s E b y E	s	w 15 s	0.60	0.62	0.00	...	...	Cum. Str. 8.	Cum. Str. 9.	Cum. 10.
7	.875	.763	.90	34.0	54.1	39.7	.186	.264	.221	87	61	86	w b y s	s w	s w	s 45 w	0 20	0.36	2.03	...	...	Clear.	Clear.	Do. 8.
8	.960	.939	.96	34.6	59.0	43.1	.194	.341	.216	87	68	73	w s w	s w	s w	w 34 s	3.62	2.90	2.71	...	...	Do.	Do.	Clear.
9	.978	.678	.50	32.3	66.1	48.7	.197	.404	.261	93	72	74	N N W	s	s s w	s 22 w	0.14	1.01	0.58	...	...	Cir. Str. 4	Do.	Cir. Cum. Str. 4.
10	.881	.964	.98	28.4	36.0	30.2	.112	.161	.138	64	69	74	N w b y w	w s w	w s w	w 4 N	27.40	11.20	1.25	...	...	Clear.	Do.	Clear, Au. Bor.
11	.900	.784	.64	11 2	51 1	39.6	.140	.274	.179	70	70	71	w s w	s w	s w	w 45 s	3.02	5 01	12·90	...	...	Cir. Str. 4.	Do.	Do. [28°
12	.881	.271	.60	35.4	33.0	26..	.192	.107	.129	84	95	80	s b y w	N E	N	w 10 N	0.75	0.41	9 75	...	0.800	Clear.	Rain & sleet.	Do. Lu. ha. diam.
13	.980	.891	.96.	15.0	32.4	29.2	.086	.160	.161	79	82	89	w N N w	w b y s	w s w	w 31 s	15 96	9.32	23.01	...	...	Cir. Str. 4.	Clear.	Lt. Cir. L. H. diam
14	.831	.673	.42	30.4	47.8	37.2	.158	.209	.226	81	59	91	s w	s w	s w b y w	w 40 s	11 21	18.16	7.07	...	1np	Rain.	Cir. Cm. Str. 8.	Rain. [24°
15	.751	.722	.88	30.6	54 2	36.7	.178	.349	.199	90	81	83	s w b y w	s s E	s w	w 22 s	2.51	2.60	0.01	...	1np	Clear.	Clear.	Lt Cir. L. H. di. 26.
16	.893	.872	.83.	32.1	49 0	41.5	.167	.233	.235	83	64	84	N E b y E	3 s E	s s E	E 15 N	2.60	0.07	8.47	...	...	Str. 4.	Cir. Cm. Str. 4.	Lai s o m 3 p.m.
17	.674	.564	.43.	37 8	53.1	45 9	207	537	282	84	81	86	N w b w	s w	w s w	w 22 s	0.40	.003	1.07	...	..	Clear.	Cir. Str. 10.	Cu s. 10. [C.C.S. 9
18	.519	.570	.66.	31.8	42.7	38.2	186	216	207	84	73	84	N E b y E	N E b E	s w	E 34 N	6.30	1.60	1.00	...	1np	Do.	Shower 10 30	Cir. Cum. Str. 4.
19	.798	.743	.83.	34.0	57.8	39.1	179	274	151	82	55	60	N	s w b y w	N E b s	E 26 N	0 01	1.42	4.25	...	...	Cir. Str. 8.	Clear.	Light Cir. Cum.
20	.994	30·009	.94.	29.6	41.9	29.4	192	235	141	72	89	80	N by E	N E b E	N E b E	N 32 E	15.24	18 06	8.24	...	...	Do.	Cum. Str. 4.	Cir. Cum. Str. 4.
21	.950	29.810	.70.	31.1	45.0	37.0	141	235	180	72	74	78	N E	N E b N	N E b E	E 34 N	33.14	30 51	33.60	...	...	Clear wh. frost	Do 6.	Nimbus 10.
22	.500	.493	.56.	35.1	45 5	40.2	203	292	245	91	93	92	N N b E	N E b E	E N E	E 34 N	35.15	4.16	0.82	...	1·240	Cir. Str. 2.	Cum. 10.	Cum. Str. 8.
23	.582	.590	.59	34.3	58.2	43.9	205	367	252	92	75	82	s w b w	s w b y w	N N E	s 32 w	0.12	1.20	0 2	...	...	Cum. Str. 6.	Cir. Str. 4.	Clear. faint Au.
24	.727	.685	.76.	41.5	65.9	57·6	241	388	315	89	67	81	N E b E	N E b E	N E b E	E 28 N	0.71	6 31	4.50	...	..	Do. 4.	Cir. Cm. Str. 4.	Cum. Str. 10. [Bor
25	.934	.987	.96.	47.1	56.9	43.0	234	297	199	69	57	68	N E	N E b E	N	E 39 N	21.82	13.80	13.41	...	...	Cir. Cm. St. 5.	Clear.	Clear.
26	30.117	.987	.86.	40.0	68.4	52 8	199	422	315	67	62	76	E	s b y E	s s w	E 10 N	12.24	2 00	8.22	...	...	Clear.	Do.	Do.
27	29.846	.814	.81.	50 0	58 2	48.2	326	412	324	87	84	92	s	s b y w	N E b E	s 34 w	4.06	1.95	11.52	...	1np	Cum. Str. 10.	Cum. Str. 10.	Cum. Str. 4.
28	.740	.707	.65.	39.0	41.0	38 0	236	247	234	92	89	94	N E b y E	N E	N E b E	E 34 N	20.98	20.92	1·74	...	0.550	Rain.	Do. 10.	Str. 10.
29	.684	.654	.85.	38.4	62·2	49.1	235	421	312	98	75	86	w s w	w s w	E W	w 4 s	15.41	12.71	11.33	...	0.083	Cir. Str. 10.	Do. 4.	Cum. Str. 4.
30	.953	30.032	30·17.	40.9	53.8	45.2	235	293	262	86	70	86	N w b w	N E	E S E	E 23 N	3.06	23·30	11.71	...	...	Str. 8.	Cir. Str. 2.	Str 2.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—MAY, 1856.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D.

Latitude—45 *deg.* 32 *min. North. Longitude*—73 *deg.* 36 *min. West. Height above the Level of the Sea*—118 *feet.*

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.				6 A.M.	2 P.M.	10 P.M.
1	30.163	29.936	29.928	34 0	68.1	49.0	.186	.384	.314	87	56	84	NE by N	S by W	S by W	Ca'm	1.12	2.80	S 10° W	...	...	Clr. Wht. Fst.	Light Cir. 4.	Clr. Aur. Bor.
2	29.765	.726	704	41.8	45.1	40.8	198	218	194	76	69	69	NE by E	NE by E	NE by E	2.30	12 95	12.50	E 34 N	Inp	...	str. 9.	Slight Rain.	Str. 9.
3	.683	.630	.718	36.1	53 1	39.4	167	207	171	74	49	70	N E	NE by N	N by E	26 51	14.85	14.71	N 30 E	...	...	Clear Frost	Clear. 19 A.M	C.C.S.10SSW.	Cir. Str. 10.
4	.700	.699	.717	35.0	40.7	40.3	167	217	245	74	79	91	NW b N	W	S W b N	7.50	10.97	9.72	W 40 N	Inp	...	Clr. Str. 8.	C.C.S.10SSW.	Cir. Str. 10.
5	.863	30.012	30.098	36.4	54 2	40.6	201	326	216	87	76	79	NE by N	E by N	E by S	14.10	13.57	3.63	N 40 E	...	...	Clr. Str 6.	Do. 4.	Clr Aur. Bor.
6	30.121	.010	29.912	33.1	68.9	49.5	178	489	290	86	67	80	W N W	S E by S	S E by S	0.15	3.72	1.10	E 34 S	...	...	Clr. Wht. Fst	Cum. Str. 4	Clear.
7	29 934	29.788	.785	46.3	65.8	49.1	243	323	290	74	52	80	E N E	N E	N E by E	12 40	9.60	3.13	N 54 E	...	...	Do.	Clear.	Do.
8	.752	.655	.722	35.4	70 6	54 3	170	400	29:	76	55	70	N E by E	N E by E	S by E	10 48	6 70	1.86	E 23 N	..	...	Do.	Cum. Str. 4.	Cum. Str. 10.
9	.748	.653	.651	49.0	58.0	51.4	280	290	338	76	59	61	E	N E by E	N by E	3.26	7.30	3.55	N 34 E	...	...	Cum. Str. 10.	Do. 8.	Do. 9.
10	.568	.600	.701	48.1	60.4	46.0	271	277	210	76	52	64	N by W	N E	W b N	5 23	20 94	1.75	N 36 E	Inp	...	Do Slgt. Rain	Do. 10.	Clear.
11	.661	.546	.83:	50·3	75.6	53.4	230	428	29:	61	50	70	N E by N	S W by S	N E by E	0.63	0.41	1.01	E 35 N	...	...	Clear.	Clear.	Do.
12	.487	.674	.894	53.0	64.1	42.6	282	357	17:	67	59	63	S W by W	W N W	N N W	1.15	14 74	11.10	W 24 S	0·100	...	Cir. Cm. St. 4	Cir. Str.	Clear.
13	990	30.106	30.043	33.5	62.0	45 5	195	397	20:	90	71	66	E N E	S W by S	S	0.46	0.47	3.75	S 33 W	...	...	Clear Frost.	Clear.	Do.
14	30.189	29.912	29 871	50.5	76.0	64 2	283	515	37:	75	53	63	S E by E	S S E	S	1.35	4.78	6 97	S 33 E	...	...	Do.	Light Cir. 1.	Cir Str 6.
15	29.804	.717	.699	60 0	72.9	61.1	410	523	48:	79	67	89	S S E	S S W	S	6.40	9 30	4.18	S 11 E	0.330	...	Cir. Str. 8.	Cir. Str. 7.	Do. 10.
16	.815	.801	.921	58.2	66.6	49.7	412	394	290	84	61	80	W N W	W	N E by E	6.00	8 62	4.15	W 7 N	0·017	...	Do. 6.	Cum. 4.	Clear.
17	.781	.811	.719	46.9	66.1	57.6	226	354	332	70	55	70	N E by E	E N E	S E	9.21	9.99	6.07	E 31 N	...	...	Clear.	Cir. Str. 4.	Cir. Str. 4.
18	.714	.705	.694	48 2	54.9	53.1	324	430	58:	93	93	94	E N E	N E	E N E	8.07	4 52	3 30	E 34 N	2 850	...	Rain.	Do. 10.	Do. 4.
19	.546	.514	.487	50.3	63.5	54.2	379	544	37:	95	90	87	N E by E	W S W	S S W	5.32	2.93	5.52	W 1 S	Inp	...	Cir. Str. 10.	Cir. Str. 9.	Do. 10.
20	.412	.476	.621	54.9	55.0	50.0	419	361	24	95	80	64	W by W	N W	N W b N	0 21	12.50	10.60	W 10 N	0.015	...	Do 10.	Do. 10.	Clear.
21	.747	.754	.782	47.6	61.0	69.6	234	304	23:	69	56	61	N by W	N by W	N W N	8.92	3.46	9.24	W 34 N	...	...	lear.	Clear.	Clear.
22	.916	.780	.811	40 9	70.1	57.7	247	400	29:	79	55	62	W by S	W S W	W S W	0.60	13.10	9.02	W 1 N	...	...	Do.	Hazy.	Cir. Str. 10.
23	.723	.604	.345	50.	78.9	70.5	304	559	515	81	55	70	S by E	S W	W S W	0.62	8.21	8.50	W 36 S	...	...	Do. Shower	Hazy.	Dense Haze.
24	.512	.384	.561	58.4	72.2	48.9	351	678	281	79	82	69	S by S	W S W	N N W	0.03	4.85	7.80	W 9 S	1 250	...	C. Str. 10. Th.	Cir Str. 4.	Cir.s Thu.Stm
25	.585	.843	.613	39.9	69.2	40.1	217	290	29:	87	80	92	W N W	N W b N	N by E	18.12	7.77	4.07	N 11 W	0.456	...	Cir. Str. 2.	Do. 9.	Rain.
26	.627	.652	.650	41.1	67·9	54	243	386	178	87	58	88	N by W	N by E	S	7.08	8.20	2.25	S 23 N	...	...	Clear.	Clear.	Str. 2.
27	.584	.390	.39:	56.1	69.9	42 7	343	461	44	94	65	84	S	S W	S by E	0.71	1.76	Calm	S 21 W	...	...	Do.	Cir, Str. 10.	Cir. Str. 4.
28	.171	.092	.322	64.6	59.4	49.1	373	452	296	87	39	80	S E	W	N N W	0.03	1.46	12.42	W 25 N	0·390	...	Rain.	Do. 10.	Str. 9.
29	.464	.493	.512	40.8	46.5	60.4	210	243	207	79	74	79	W N W	W S W	N W b N	1.08	2.62	1.08	W 30 N	...	...	Str. 10.	Do. 9.	Cir. Str. 9.
30	.477	.402	.594	40 0	43·7	41·7	227	282	225	85	85	79	N N W	N W	N W	6.23	8·52	11·60	W 27 N	0·559	...	Rain.	Rain.	Cir. Str. 9.
31	.710	.687	.786	40.0	50·6	67·7	179	246	252	67	65	74	W by W	W by N	W S W	18·64	21·31	15.91	W 6 S	...	...	Clr. Sl. Snow	Cir. Str. 8.	Do 2.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR APRIL.

Barometer.....	Highest, the 1st day	30.241
	Lowest, the 12th day	29.271
	Monthly Mean	29.775
	Monthly Range	0.970
Thermometer ...	Highest, the 25th day	78° 1'
	Lowest, the 1st day	8° 5'
	Monthly Mean	41° 24'
	Monthly Range	69° 6'
Greatest Intensity of the Sun's Rays		107° 10'
Lowest Point of Terrestrial Radiation		8°00'
Amount of Evaporation		1.94 in.
Mean of Humidity		.800

No snow fell during the month, which is the only April on record here.
Rain fell on 11 days, amounting to 2 830 inches; it was raining 37 hours 30 minutes.
The amount of rain which fell in the month is much below the usual quantity for April on record here, for in April, 1855, 4.194 inches of rain fell, and 4.34 inches of snow; and in April, 1854, 7.886 inches of rain fell, and 4.03 inches of snow; and in April, 1853, 3.536 inches of rain fell, and 1.50 inches of snow.
The first rain which fell since the 22nd of December, was on the 3rd of April, making a period of 103 days without rain. The amount of evaporation is + the average, and the relative humidity — the average amount.
The most prevalent Wind was N E by E—1699.00 miles.
The least prevalent Wind was S W by S—3.00 miles.
The most windy day was the 21st; mean miles per hour, 32.41.
The least windy day was the 6th; mean miles per hour, 0.40.
Most windy hour, from 5 to 6 A. M. on the 10th day—3.650 miles.
There were 247 hours calm during the month.
The whole miles traversed by the wind was 4579.10 miles, which being resolved into the four cardinal points, gives—

N—234.00 S—116.00 W—1644.00 E—2585.10

Ozone—was in large quantity, amounting to saturation, on the 28th day.
Eclipse of the Moon visible on the morning of the 21st day.
The electrical state of the atmosphere has indicated rather high tension.
The *Rossignol* first heard on the 6th day.
Swallows first seen on the 19th day.
Frogs first heard on the 23rd day.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR MAY.

Barometer.....	Highest, the 1st day	30.163
	Lowest, the 28th day	29.092
	Monthly Mean	29 727
	Monthly Range	1.071
Thermometer ...	Highest, the 23rd day	83°.40
	Lowest, the 3rd day	30°.00
	Monthly Mean	52°.45
	Monthly Range	53°.40
Greatest Intensity of the Sun's Rays		110°.5
Lowest Point of Terrestrial Radiation		29°.6
Mean of Humidity		.735
Amount of Evaporation		3.79

Snow fell on 2 days, inapp.
Rain fell on 13 days amounting to 5 973 inches; it was raining 42 hours and 50 minutes. and was accompanied by thunder on 2 days.
Most prevalent Wind, the N. W. by N.
Least prevalent Wind, the E. by S.
Most windy day, the 3rd day; mean miles per hour 18.36.
Least windy day, the 27th day; mean miles per hour, 0.40.
Most windy hour from 11 to 12, A. M., 31st day. 32.30 miles;—total miles traversed by the wind, 4540.00 —which being resolved into the Four Cardinal Points, gives N 1415.00. S 481.00, E 1321.00, W 1323.00 miles,
Aurora Borealis visible on two nights.
There were 179 hours calm during the month, and 4 days perfectly cloudless.
The electrical state of the atmosphere has been marked generally by moderate intensity.
Ozone—was in moderate quantity.